AN UPDATE OF THE ONTARIO MINISTRY OF NATURAL RESOURCES MODEL OF THE WORLD MARKETS FOR COPPER, ALUMINUM, NICKEL AND ZINC

Mineral Policy Background Paper N

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NOTE:
This background discussion paper does not represent official policy and the views expressed herein are not necessarily the viewpoint of the Government of Ontario.

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By

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-INTRODUCTION-

This report represents an update of the analyses performed for the Ontario Ministry of Natural Resources. Hence, the basic philosophy and techniques are as described in World Mineral Markets, Stage II: An Econometric and Simulation Approach to the World Markets for Copper, Aluminum, Nickel and Zinc (OMNR Background Paper #14, October 1981) and World Mineral Markets, Stage III: A User Oriented Simulation Model of the World Markets for Copper, Aluminum, Nickel, and Zinc (OMNR Background Paper #15, October 1981).

The primary objective of this project was to extend the observation period beyond the 1976 data used in the analyses noted above, and then use that expanded data set to reestimate the equations used in the simulation model. In this way, the resulting updated simulation model will reflect the most recent behavior of the markets. A second objective was concerned specifically with the nickel market. As we have noted in our preceding publications, we feel that this market has experienced a change in structure. That is, we feel that more recent market behavior tends to follow an economic paradigm that is potentially different than that which was applicable for the earlier periods. In this analysis we will approach that problem directly. We will examine the nickel market to determine if there exists any evidence of a change in structure. Then, we will incorporate the prevailing structure in our simulation model.

Our report is organized as follows: In Part I, we first present an overview of the methodology that will be followed. Then, for each mineral commodity, we present the updated data and the resulting simulation model. Part II contains the revisions to the computer simulation model.

PART I

The Econometric Models

-METHODOLOGY-

As noted in the introduction, this update of the econometric/simulation model employs the same techniques as employed in the original model.* For each of the mineral commodities the work was accomplished in four steps as outlined in the following:

Data Extension and Revision

Each of our data series was extended. In all cases, the variable definitions and data sources are exactly those used in the original modeling effort. Our objective was to obtain the most current data available. In the case of production, consumption, and price for the mineral commodities, we were able to obtain data through 1980. However, in the case of the country group data, we were not as fortunate. These data are presented in the following tables. (Note that, in all of our data tables, the number in parentheses corresponds to the table number for that data in World Mineral Markets, Stage II.) While data for interest rates and money growth rates were available through 1980, the United Nations data — i.e., "Index of Per Capita Gross Domestic Product" and "Index of Gross Fixed Capital Formation" — were available only through 1979. (An attempt to obtain the 1980 data directly from the United Nations proved futile.)

In the extended data series, some previously reported values have been changed. For the most part, this reflects revisions reported in the source documents. However, errors noted in the original series have been corrected.

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*The basic techniques employed are relatively standard for econometric models. For example, see Robert S. Pindyck and Daniel L. Rubinfeld, Econometric Models and Economic Forecasts, New York: McGraw-Hill, 1981.

INDEX OF PER CAPITA GROSS DOMESTIC PRODUCT (5-1)

YEAR	YNA	YSA	YAS	YAF	YEU	YOC	YCP
1947	.	.	.	.	.	.	.
1948	.	.	.	.	.	.	.
1949	.	.	.	.	.	.	.
1950	0.65	0.60	0.46	0.64	0.47	0.66	0.28
1951	0.70	0.65	0.47	0.65	0.50	0.65	0.30
1952	0.71	0.65	0.49	0.67	0.51	0.63	0.32
1953	0.72	0.65	0.50	0.70	0.53	0.65	0.34
1954	0.70	0.67	0.51	0.72	0.55	0.69	0.37
1955	0.74	0.70	0.53	0.73	0.58	0.70	0.41
1956	0.74	0.71	0.55	0.75	0.60	0.70	0.43
1957	0.74	0.74	0.57	0.76	0.62	0.70	0.47
1958	0.72	0.76	0.58	0.78	0.63	0.72	0.51
1959	0.75	0.76	0.60	0.79	0.65	0.74	0.53
1960	0.77	0.76	0.66	0.79	0.67	0.75	0.58
1961	0.76	0.79	0.67	0.84	0.71	0.74	0.60
1962	0.79	0.80	0.69	0.84	0.74	0.77	0.63
1963	0.83	0.80	0.73	0.83	0.76	0.80	0.65
1964	0.85	0.85	0.76	0.89	0.80	0.84	0.70
1965	0.89	0.86	0.79	0.88	0.82	0.85	0.73
1966	0.93	0.88	0.83	0.88	0.84	0.89	0.78
1967	0.95	0.89	0.86	0.89	0.87	0.89	0.83
1968	0.99	0.92	0.92	0.93	0.91	0.95	0.90
1969	1.00	0.97	0.95	0.97	0.96	0.98	0.93
1970	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1971	1.02	1.04	1.07	1.02	1.02	1.02	1.05
1972	1.07	1.08	1.15	1.04	1.07	1.05	1.09
1973	1.12	1.13	1.22	1.05	1.12	1.10	1.17
1974	1.10	1.18	1.28	1.09	1.13	1.10	1.24
1975	1.07	1.20	1.28	1.08	1.11	1.09	1.29
1976	1.12	1.26	1.34	1.16	1.17	1.12	1.37
1977	1.19	1.32	1.43	1.21	1.19	1.12	1.43
1978	1.24	1.38	1.51	1.26	1.22	1.17	1.51
1979	1.27	1.46	1.59	1.32	1.27	1.19	1.55
1980	.	.	.	.	.	.	.

INDEX OF GROSS FIXED CAPITAL FORMATION (5-2)

YEAR	KNA	KSA	KAS	KAF	KEU	KOC	KCP
1947	.	.	.	.	.	.	.
1948	.	.	.	.	.	.	.
1949	.	.	.	.	.	.	.
1950	0.54	.	.	.	0.27	0.35	.
1951	0.55	.	.	.	0.28	0.37	.
1952	0.55	.	.	.	0.29	0.39	.
1953	0.56	.	.	.	0.31	0.41	.
1954	0.57	.	.	.	0.35	0.44	.
1955	0.63	.	.	.	0.39	0.46	.
1956	0.65	.	.	.	0.42	0.45	.
1957	0.64	.	.	.	0.44	0.48	.
1958	0.62	.	.	.	0.45	0.50	.
1959	0.67	.	.	.	0.49	0.54	.
1960	0.66	0.54	0.46	0.56	0.54	0.57	.
1961	0.66	0.57	0.47	0.58	0.60	0.58	.
1962	0.71	0.59	0.48	0.61	0.63	0.61	.
1963	0.74	0.57	0.53	0.63	0.67	0.68	.
1964	0.79	0.63	0.59	0.68	0.74	0.77	.
1965	0.83	0.64	0.65	0.75	0.77	0.81	.
1966	0.92	0.71	0.71	0.73	0.80	0.83	.
1967	0.90	0.74	0.76	0.78	0.82	0.85	.
1968	0.95	0.84	0.86	0.83	0.87	0.91	.
1969	0.98	0.92	0.94	0.91	0.93	0.95	.
1970	1.00	1.00	1.00	1.00	1.00	1.00	.
1971	1.05	1.08	1.11	1.11	1.03	1.01	.
1972	1.15	1.17	1.29	1.19	1.08	0.98	.
1973	1.23	1.27	1.42	1.27	1.15	1.03	.
1974	1.14	1.47	1.65	1.41	1.11	1.05	.
1975	1.02	1.53	2.12	1.64	1.06	1.08	.
1976	1.08	1.59	2.23	1.75	1.08	1.12	.
1977	1.16	1.64	2.37	1.92	1.09	1.07	.
1978	1.24	1.74	2.63	1.95	1.10	1.09	.
1979	1.26	1.87	2.78	1.98	1.14	1.07	.
1980	.	.	.	.	.	.	.

INTEREST RATES (5-3)

YEAR	RNA	REU	ROC
1947	2.2682	4.4992	3.1300
1948	2.4674	4.9662	3.1065
1949	2.3396	5.0988	3.0918
1950	2.3462	5.6490	3.1235
1951	2.6082	6.0771	3.4242
1952	2.7437	6.0280	4.2410
1953	2.9753	5.4924	4.3891
1954	2.5662	5.0089	4.3630
1955	2.8238	5.1695	4.4453
1956	3.0999	5.7333	4.9532
1957	3.5723	6.2964	4.9812
1958	3.5260	5.9938	4.9661
1959	4.1993	5.4226	4.8984
1960	4.1418	5.7963	4.9590
1961	4.0025	5.7889	5.2331
1962	4.0784	5.6219	4.9834
1963	4.1228	5.5292	4.6894
1964	4.2600	5.7759	4.7853
1965	4.3358	6.3494	5.1889
1966	4.8344	6.8767	5.2558
1967	5.0816	6.5051	5.2893
1968	5.5593	6.5809	5.2583
1969	6.4262	7.6960	5.7692
1970	6.9408	8.4761	6.5627
1971	6.1839	8.1640	6.7086
1972	6.1247	7.9464	5.9581
1973	7.1613	9.2747	6.9682
1974	8.1390	11.4083	8.6842
1975	8.2699	10.1431	9.2678
1976	7.9931	9.7298	9.9463
1977	7.7600	8.8500	10.1400
1978	8.5600	8.4000	9.4900
1979	9.4100	9.4000	10.0900
1980	11.4900	11.2100	11.8800

MONEY GROWTH RATES (5-4)

YEAR	MGNA	MGEU	MGOC
1947	2.8290	11.4774	4.6410
1948	-1.3787	14.3540	17.6030
1949	0.1140	14.2375	17.1435
1950	6.2280	9.5570	21.4150
1951	5.3751	11.4415	11.7270
1952	3.7960	8.0854	-4.0920
1953	1.2250	7.9026	13.3292
1954	3.4080	10.0658	3.5302
1955	2.6520	6.8446	1.7950
1956	0.8670	5.4500	0.2212
1957	-0.5788	6.2051	3.8688
1958	2.2643	5.8295	-0.7970
1959	3.0343	8.9145	2.5536
1960	0.2000	7.7809	6.7580
1961	2.2840	8.3719	-3.9942
1962	1.7870	9.4646	1.5664
1963	3.3500	9.6413	3.5384
1964	3.9030	8.1164	7.2544
1965	4.9680	7.2688	0.3384
1966	4.8730	5.4389	1.7856
1967	5.0778	4.4174	5.3051
1968	7.2921	6.1710	6.1487
1969	4.6148	5.9107	7.4903
1970	2.9763	4.9867	5.[illegible]98
1971	6.9156	13.0757	5.2926
1972	7.7324	14.1982	12.1460
1973	7.5512	7.8570	24.1048
1974	4.4800	7.4225	4.2152
1975	4.8100	12.9500	12.4284
1976	5.2300	12.6300	13.7200
1977	7.2000	9.8100	7.6400
1978	7.4400	14.4300	8.6900
1979	5.7200	9.9100	15.9900
1980	6.5100	4.8000	13.8600

Note that the mineral prices are expressed in 1967 U.S. dollars. In the simulation output, the prices are expressed in 1979 U.S. dollars. (To convert 1967 prices to 1979 prices, multiply by 2.356.)

Estimation

The primary production, secondary production, consumption, and price equations developed in the original analyses were reestimated using the extended and revised data series. (The income and capital growth rate data required that the estimation period end in 1979.) While the basic models are unchanged, the estimations reported in the this report incorporated more dummy variables than in the original modeling effort. We included these additional dummy variables in order to obtain more precise estimates of the coefficients of the variables included in our model.

Finalization of the Simulation Model

Once the individual equations were estimated, they were combined to form our simultaneous-equations simulation model. In order to evaluate the performance of the model, we again performed in-sample predictions. The in-sample predictions were obtained in precisely the same manner as described in Chapter 10 of World Mineral Markets, Stage II. In this analysis, the in-sample period was 1965-1979. By comparing actual and predicted values, we can ascertain how well the model performed. For each of the mineral commodities, we report these actual and predicted values (and provide plots for the world values). Some commonly used descriptive statistics for evaluating the preformance of an econometric simulation model are:

(1) Mean Error

$$ME = \frac{1}{T} \sum_{t=1}^{T} (P_t - A_t)$$

(2) Mean Percentage Error

$$MPE = \frac{1}{T} \sum_{t=1}^{T} \frac{P_t - A_t}{A_t}$$

(3) Root Mean Squared Error

$$RMSE = \sqrt{\frac{1}{T} \sum_{t=1}^{T} (P_t - A_t)^2}$$

(4) Root Mean Squared Percentage Error

$$RMSPE = \sqrt{\frac{1}{T} \sum_{t=1}^{T} \left(\frac{P_t - A_t}{A_t}\right)^2}$$

where P is the predicted value, A is the actual value, and T is the number of periods in the simulation. These statistics are also reported for our in-sample predictions.

On the basis of the results of the in-sample predictions and some arbitrary future simulations, we determined the "best" simulation model. That is, for some of the individual equations we tried several variants of the basic model and selected the one that performed best in the context of the simulation model.

Simulation

Once the simulation equations have been selected, they are put into the simulation model described in World Mineral Markets, Stage III. This model can then be used to obtain predictions for the future values of pro-

duction, consumption and price. For each of the mineral commodities we present the simulation equations that will be used in the simulation model. The parameters in these equations are arranged in the order provided in Table B-1 (pg 159) of World Mineral Markets, Stage III.

-COPPER-

Data

The updated data for copper are displayed in the following tables. In these tables please note that (1) prices are expressed in 1967 U.S. dollars and (2) the updated data reflect the revisions contained in the most recent issue of Metal Statistics.

COPPER: PRIMARY PRODUCTION (6-1)

YEAR	CPNA	CPSA	CPAS	CPAF	CPEU	CPOC	CPCP
1947	973.8	535.7	53.5	382.8	60.0	13.3	207.4
1948	975.7	549.6	63.4	420.8	66.5	12.6	231.4
1949	921.9	479.6	82.8	441.9	72.6	13.8	251.3
1950	1064.6	480.3	93.1	519.9	70.2	15.1	276.1
1951	1087.1	504.6	104.5	559.3	74.2	16.9	306.4
1952	1073.6	520.9	124.4	587.2	76.4	20.4	351.0
1953	1070.2	478.3	125.4	639.3	72.9	37.1	370.4
1954	1032.5	477.6	148.0	681.6	71.1	41.5	390.8
1955	1201.6	554.7	153.4	663.1	80.6	48.1	401.1
1956	1323.6	611.5	184.9	738.3	85.1	55.4	460.7
1957	1311.8	619.2	203.9	770.8	94.2	60.3	478.3
1958	1201.5	601.4	202.8	740.6	100.0	76.9	498.0
1959	1106.9	665.5	219.0	936.3	94.4	96.5	523.6
1960	1378.4	794.4	216.1	982.6	94.9	111.2	585.0
1961	1455.3	808.2	224.6	981.4	98.6	97.2	635.1
1962	1536.3	811.5	231.2	965.6	96.6	110.8	679.3
1963	1511.2	854.9	246.1	988.4	89.8	114.8	733.9
1964	1572.8	871.7	240.3	1044.2	93.0	106.3	786.8
1965	1687.0	842.6	250.1	1121.9	86.9	91.8	799.1
1966	1755.6	914.3	263.3	1140.6	85.5	111.3	857.8
1967	1421.9	929.7	277.8	1182.2	90.0	91.8	966.3
1968	1667.3	954.4	306.3	1206.2	98.7	109.6	1013.5
1969	1921.2	971.4	327.4	1284.8	115.7	130.8	1093.4
1970	2170.3	991.8	353.8	1295.1	114.8	157.8	1206.0
1971	2035.4	999.0	385.2	1305.7	136.0	177.3	1315.2
1972	2230.0	1032.3	401.1	1418.2	150.9	309.8	1391.6
1973	2382.4	1033.4	433.3	1494.6	182.4	403.2	1450.3
1974	2270.2	1210.8	455.1	1499.8	168.7	435.4	1485.9
1975	2016.0	1085.3	452.1	1462.3	180.8	391.5	1574.3
1976	2187.5	1326.4	482.1	1471.6	178.1	395.0	1637.8
1977	2123.8	1483.1	508.7	1472.8	182.4	403.9	1619.8
1978	2017.0	1506.4	477.4	1371.0	176.9	420.7	1702.9
1979	1779.9	1577.3	509.9	1287.3	169.1	408.2	1738.9
1980	1876.7	1615.2	491.2	1357.8	168.1	378.6	1751.6

COPPER: SECONDARY PRODUCTION (6-2)

YEAR	CSCRNA	CSCRSA	CSCRAS	CSCREU	CSCROC
1947	.	.	.	.	.
1948	251.3	0.0	25.1	103.2	0.0
1949	220.6	0.0	38.5	172.5	0.0
1950	219.4	0.0	47.9	190.5	0.0
1951	150.3	0.0	50.2	199.3	0.0
1952	139.4	0.0	45.1	181.9	0.0
1953	193.0	0.0	27.4	208.3	0.0
1954	186.9	0.0	36.7	215.3	0.0
1955	218.3	0.0	32.4	252.7	0.0
1956	238.3	0.0	33.7	236.2	0.0
1957	215.2	0.0	33.3	195.6	0.0
1958	210.9	0.0	20.6	193.8	0.0
1959	230.9	0.0	39.0	226.6	0.0
1960	264.7	0.0	60.9	237.9	0.0
1961	239.2	0.0	74.2	297.3	14.9
1962	247.4	0.0	58.3	330.6	12.0
1963	261.4	0.0	43.1	316.8	16.6
1964	303.1	0.0	59.5	347.3	20.5
1965	399.2	0.0	65.6	403.2	34.5
1966	441.5	7.0	85.9	454.7	24.0
1967	386.1	8.0	67.2	441.1	29.8
1968	403.3	12.0	71.2	552.8	35.2
1969	461.3	15.0	108.0	496.8	37.7
1970	450.3	20.0	102.2	536.7	41.3
1971	354.3	25.0	103.0	442.4	34.8
1972	375.5	26.0	103.3	446.6	34.6
1973	434.9	30.5	133.3	426.7	33.1
1974	464.0	39.8	127.2	497.2	32.0
1975	325.8	34.2	88.6	405.6	27.7
1976	349.6	39.1	104.6	424.4	28.0
1977	351.7	34.6	102.4	403.3	31.1
1978	417.9	30.9	148.1	392.4	22.8
1979	495.9	43.9	155.7	419.0	33.1
1980	507.8	50.0	139.2	428.0	36.6

COPPER: CONSUMPTION (6-3)

YEAR	CCNA	CCSA	CCAS	CCAF	CCEU	CCOC	CCCP
1947	1426.6	47.8	63.1	15.3	855.0	30.5	252.0
1948	1388.3	42.5	93.5	26.4	889.2	32.7	308.0
1949	1116.3	62.8	77.7	23.3	906.2	34.5	362.5
1950	1389.2	61.7	100.5	23.3	981.9	33.3	318.1
1951	1407.1	89.5	133.6	25.9	1037.7	37.9	441.3
1952	1460.6	70.5	131.3	25.8	1067.1	36.0	489.8
1953	1451.2	63.2	125.8	21.0	939.1	35.9	499.5
1954	1231.2	92.0	127.8	20.3	1328.1	40.4	519.3
1955	1488.3	81.4	137.4	22.3	1442.2	52.4	531.1
1956	1512.0	58.3	190.8	26.1	1463.5	44.1	581.1
1957	1333.9	77.3	229.2	34.7	1557.8	50.1	622.7
1958	1248.1	100.7	221.6	33.9	1643.8	59.8	649.7
1959	1445.1	93.1	287.9	26.6	1583.8	59.7	782.9
1960	1331.3	90.1	384.4	30.9	1870.7	73.5	847.0
1961	1455.7	95.8	462.4	32.4	1939.3	61.5	863.1
1962	1551.7	93.2	406.2	37.5	1850.8	69.0	900.0
1963	1749.9	101.9	454.7	43.8	1917.0	83.7	976.9
1964	1879.6	158.2	540.9	48.2	2112.0	99.1	1040.4
1965	2054.6	166.9	504.6	44.5	2098.3	102.3	1104.0
1966	2403.4	126.8	536.2	38.0	1940.6	108.0	1159.7
1967	2003.6	109.2	682.9	37.8	1907.4	88.4	1227.5
1968	1936.2	162.6	761.4	39.7	2108.1	104.7	1263.2
1969	2172.3	186.9	893.0	44.8	2267.2	106.4	1303.7
1970	2089.2	182.3	918.2	44.0	2399.1	114.1	1351.6
1971	2053.8	224.0	909.8	58.0	2295.8	117.3	1413.0
1972	2253.7	256.3	1085.1	66.1	2427.6	112.8	1506.7
1973	2452.1	269.7	1335.4	84.4	2565.7	135.3	1613.7
1974	2242.9	313.9	1009.6	92.5	2570.0	122.5	1660.1
1975	1581.7	306.3	953.2	87.3	2303.3	97.7	1806.7
1976	2014.2	367.4	1223.4	76.3	2527.3	121.4	1873.9
1977	2208.1	389.0	1310.6	75.8	2649.8	107.9	1952.6
1978	2443.2	375.2	1465.3	94.7	2630.5	125.8	2009.4
1979	2408.2	473.8	1589.5	96.8	2717.3	128.8	2073.7
1980	2074.7	486.9	1636.9	115.9	2727.0	132.4	2025.1

COPPER: WORLD PRODUCTION, CONSUMPTION, AND PRICES (6-4)

YEAR	CPWRLD	CSCRWRLD	CCWRLD	PC	PA
1947	2226.5	.	2690.3	30.7058	18.3007
1948	2320.0	379.6	2780.6	29.1160	17.7935
1949	2263.9	431.6	2583.3	27.5267	20.3304
1950	2519.3	457.8	2908.0	27.3233	20.4315
1951	2653.0	399.8	3173.0	30.0462	19.7585
1952	2753.9	366.4	3281.1	36.7206	20.7788
1953	2793.6	428.7	3135.7	36.5054	22.5458
1954	2843.1	438.9	3359.1	35.5850	23.0639
1955	3102.6	503.4	3755.1	49.8828	24.9260
1956	3459.5	508.2	3875.9	45.2650	26.4961
1957	3538.5	444.1	3905.7	29.3384	27.2412
1958	3421.2	425.3	3957.6	26.1726	26.2051
1959	3642.2	496.5	4279.1	31.4499	26.0949
1960	4162.6	563.5	4627.9	32.4862	27.3973
1961	4300.4	625.6	4910.2	30.3914	26.9397
1962	4431.3	648.3	4908.4	30.9385	25.1846
1963	4539.1	637.9	5327.9	30.9869	23.9397
1964	4715.1	730.4	5878.4	46.2151	25.0697
1965	4879.4	902.5	6075.2	60.4853	25.3696
1966	5128.4	1013.1	6312.7	69.3448	24.5491
1967	4959.7	932.2	6056.8	51.2604	24.9780
1968	5356.0	1074.5	6375.9	54.7700	24.9590
1969	5844.7	1118.8	6974.3	62.1942	25.5174
1970	6289.6	1150.5	7098.5	58.0221	26.0109
1971	6353.8	959.5	7071.7	42.3591	25.4609
1972	6933.9	986.0	7688.3	40.7599	22.1738
1973	7379.6	1058.5	8456.3	60.0386	18.5598
1974	7525.9	1160.2	8011.5	58.1813	21.3198
1975	7162.3	881.9	7136.2	32.0690	22.7479
1976	7678.5	945.7	8203.9	34.9529	24.2301
1977	7794.5	923.1	8693.8	30.6075	26.4361
1978	7672.3	1012.1	9144.1	29.5288	25.3583
1979	7470.6	1147.6	9488.1	30.0507	25.2101
1980	7639.2	1161.6	9198.9	36.9538	25.8898

Estimation

In the estimation of the individual equations, several dummy variables were used. In the case of primary production in Oceania, the data exhibits a "stair-step" pattern. We viewed this as a reflection of new production coming on line; so, we employed four dummy variables to reflect the increases in production in 1953, 1958, 1969, 1972, and 1973. In the case of consumption, the only dummy variables used were employed to account for the severe decline in consumption associated with the recession of 1975-76. Such dummies were used in the equations for North America, Asia, Africa, Europe, and Oceania. In the price equation, we used a dummy variable for the period 1964-1974. With the data available to us, we were not able to explain (in the econometric sense) the substantial increase in real price over this period.

Finalization

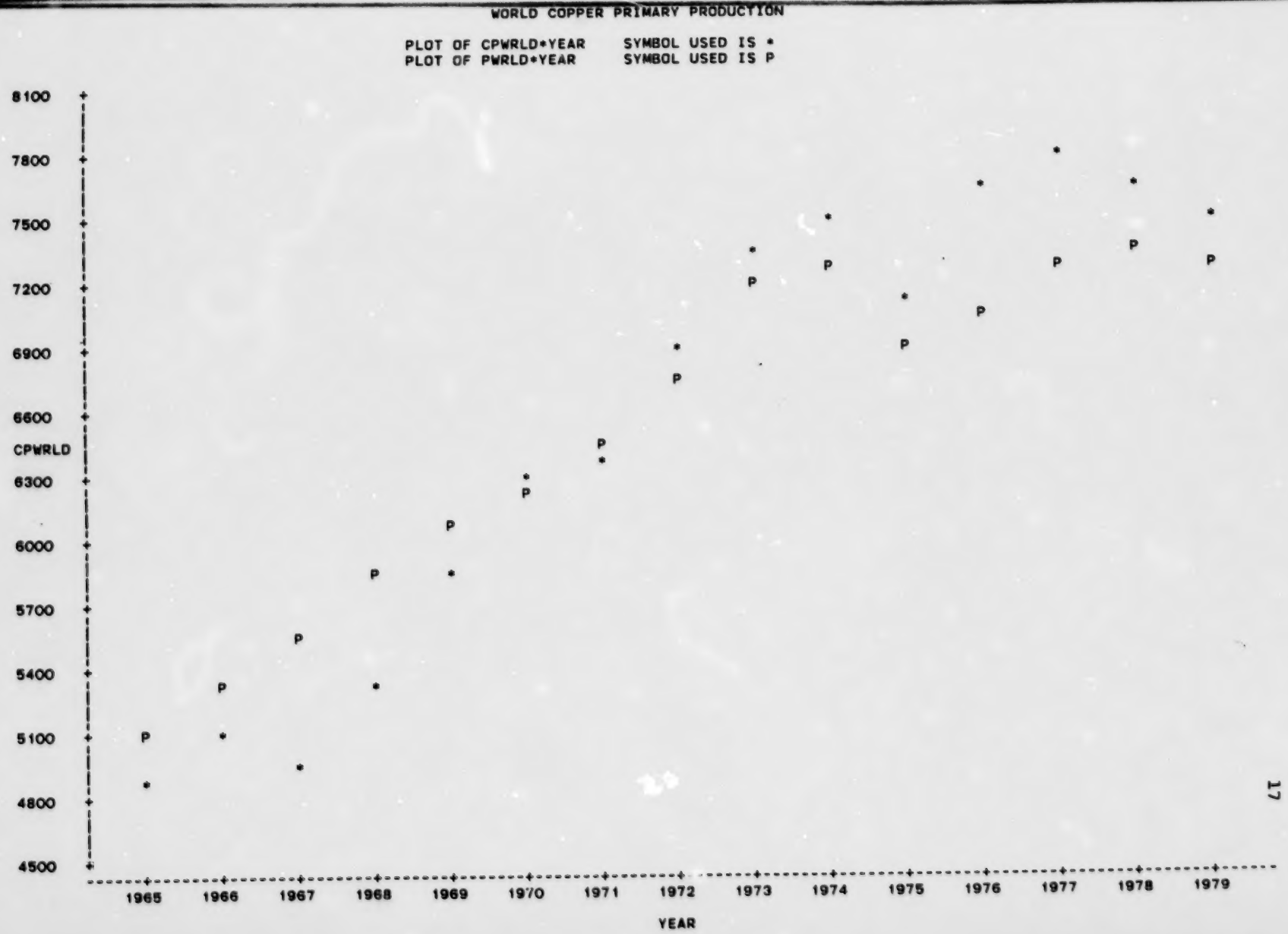
Combining the 20 equations that make up the copper model, we performed the in-sample predictions for the period 1965-1979. In the following table we present the actual and predicted values obtained from the specification we selected. (Note that actual values are always presented first and that prices are expressed in 1979 U.S. dollars.) We also plotted actual and predicted values for the world values. (Actual values are identified with the symbol * and predicted with the symbol P). Finally, we provide the statistics normally used to evaluate econometric predictions -- i.e., mean error, mean percentage error, root mean squared error, and root mean squared percentage error -- for the individual equations.

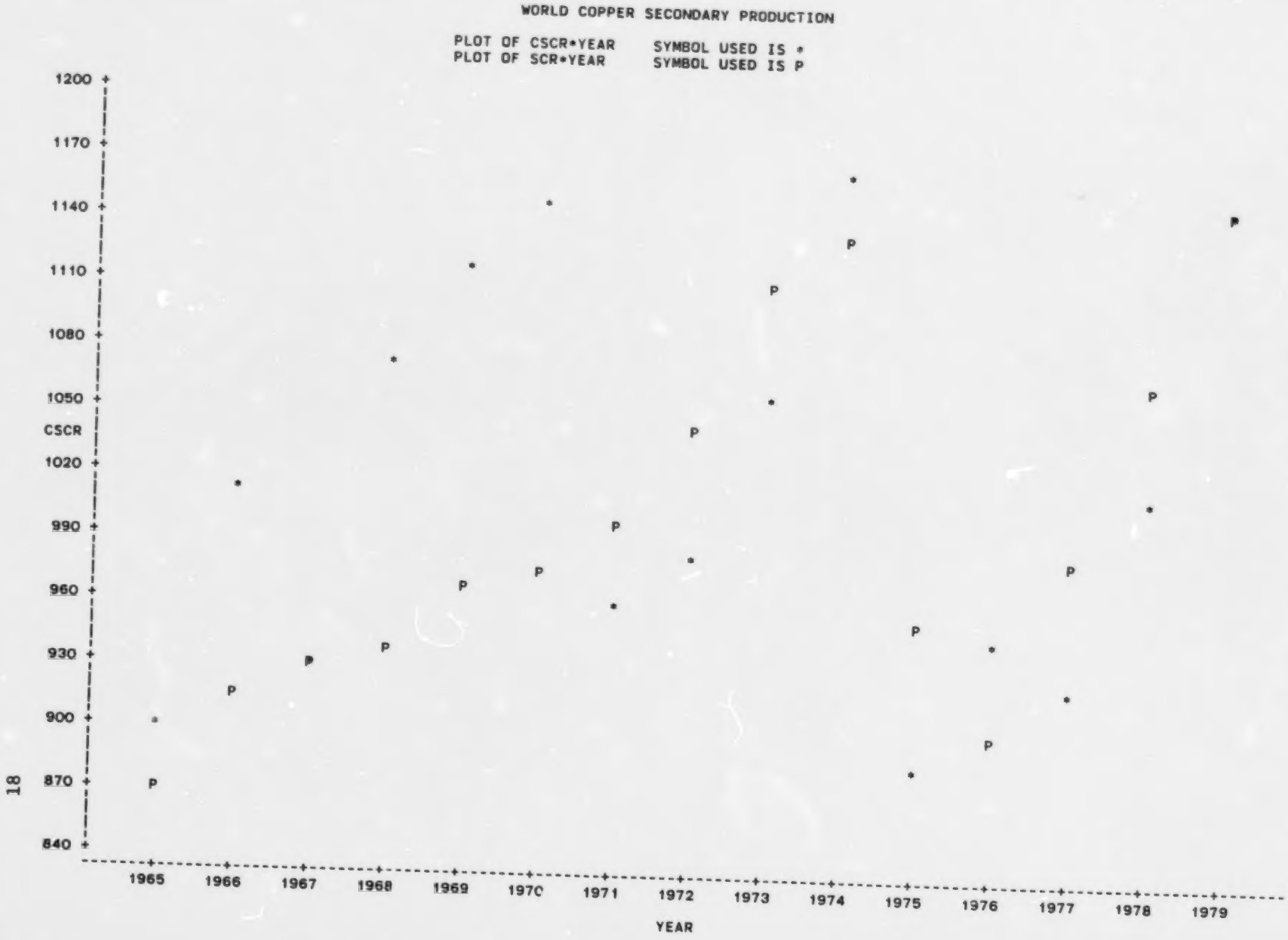
COMPARISON OF ACTUAL AND PREDICTED VALUES -- COPPER

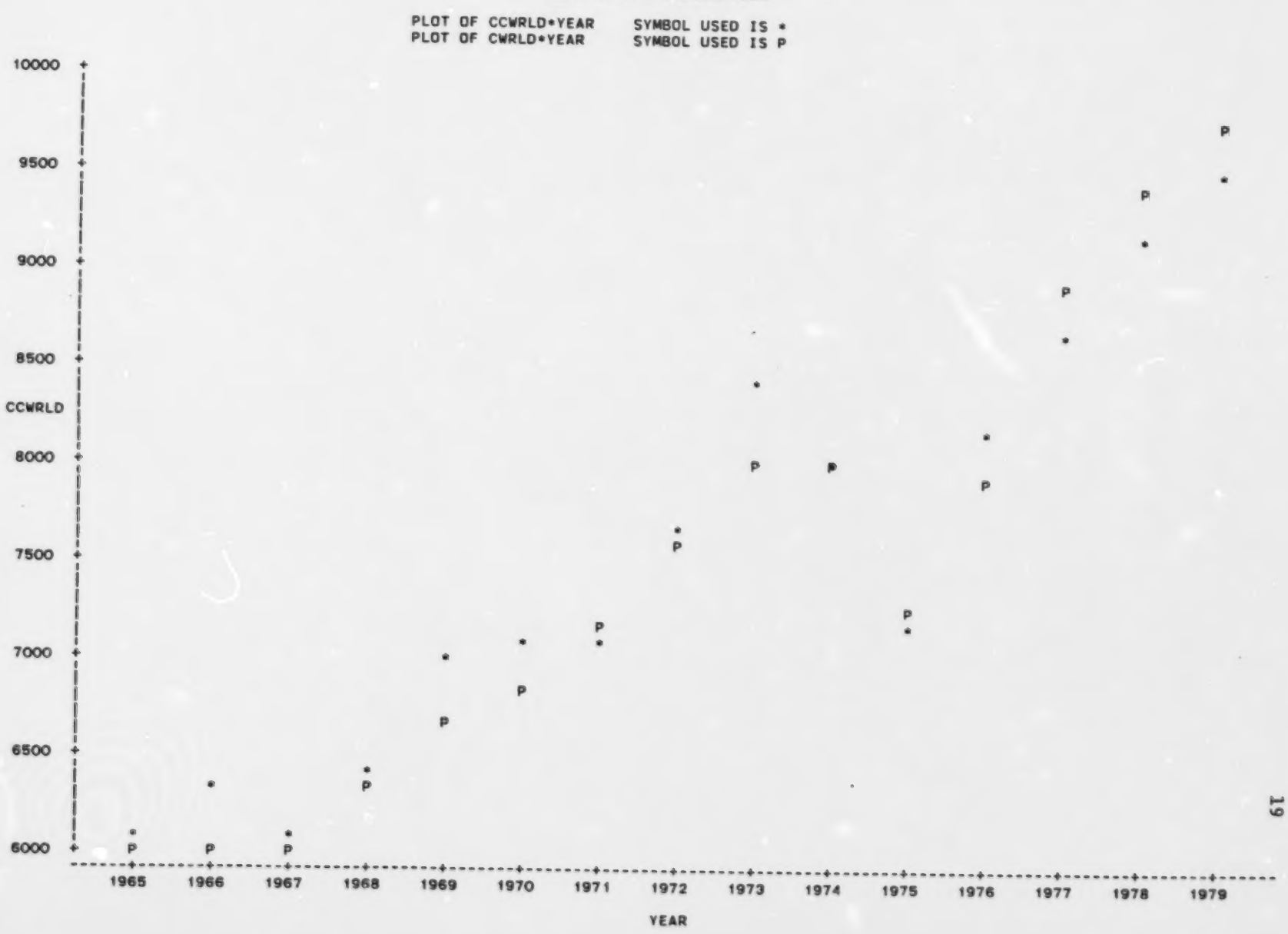
YEAR	CCNA	CNA	CCSA	CSA	CCAS	CAS	CCAF	CAF	CCEU	CEU	CCOC	COC
1965	2054.6	1960.03	166.9	130.690	504.6	612.53	44.5	50.5625	2098.3	2103.97	102.3	97.173
1966	2403.4	2029.38	126.8	130.408	536.2	633.68	38.0	52.0854	1940.6	1942.00	108.0	101.786
1967	2003.6	1982.88	109.2	136.621	682.9	651.19	37.8	53.3730	1907.4	1930.75	88.4	86.460
1968	1936.2	2087.61	162.6	161.839	761.4	719.72	39.7	54.9358	2108.1	1974.27	104.7	104.223
1969	2172.3	2008.35	186.9	207.924	893.0	820.87	44.8	58.1545	2267.2	2133.42	106.4	108.423
1970	2089.2	1922.85	182.3	208.120	918.2	834.95	44.0	62.7729	2399.1	2289.82	114.1	107.026
1971	2053.8	1991.82	224.0	231.191	909.8	896.89	58.0	68.1005	2295.8	2427.00	117.3	107.829
1972	2253.7	2209.55	256.3	248.313	1065.1	1062.83	66.1	73.5532	2427.6	2342.00	112.8	111.474
1973	2452.1	2359.52	269.7	275.987	1335.4	1198.54	84.4	79.1117	2565.7	2416.11	135.3	122.193
1974	2242.9	2086.61	313.9	297.865	1009.6	1169.60	92.5	84.2853	2570.0	2586.89	122.5	115.506
1975	1581.7	1676.28	306.3	296.024	953.2	918.44	87.3	77.9371	2303.3	2466.75	97.7	104.031
1976	2014.2	1892.94	367.4	352.168	1223.4	1248.20	76.3	72.0959	2527.3	2430.68	121.4	117.453
1977	2208.1	2361.88	389.0	384.893	1310.6	1346.93	75.8	70.9523	2649.8	2690.37	107.9	116.354
1978	2443.2	2545.26	375.2	407.983	1465.3	1449.92	94.7	84.9768	2630.5	2795.11	125.8	134.305
1979	2408.2	2567.37	473.8	454.449	1589.5	1602.79	96.8	99.2050	2717.3	2821.81	128.8	139.753

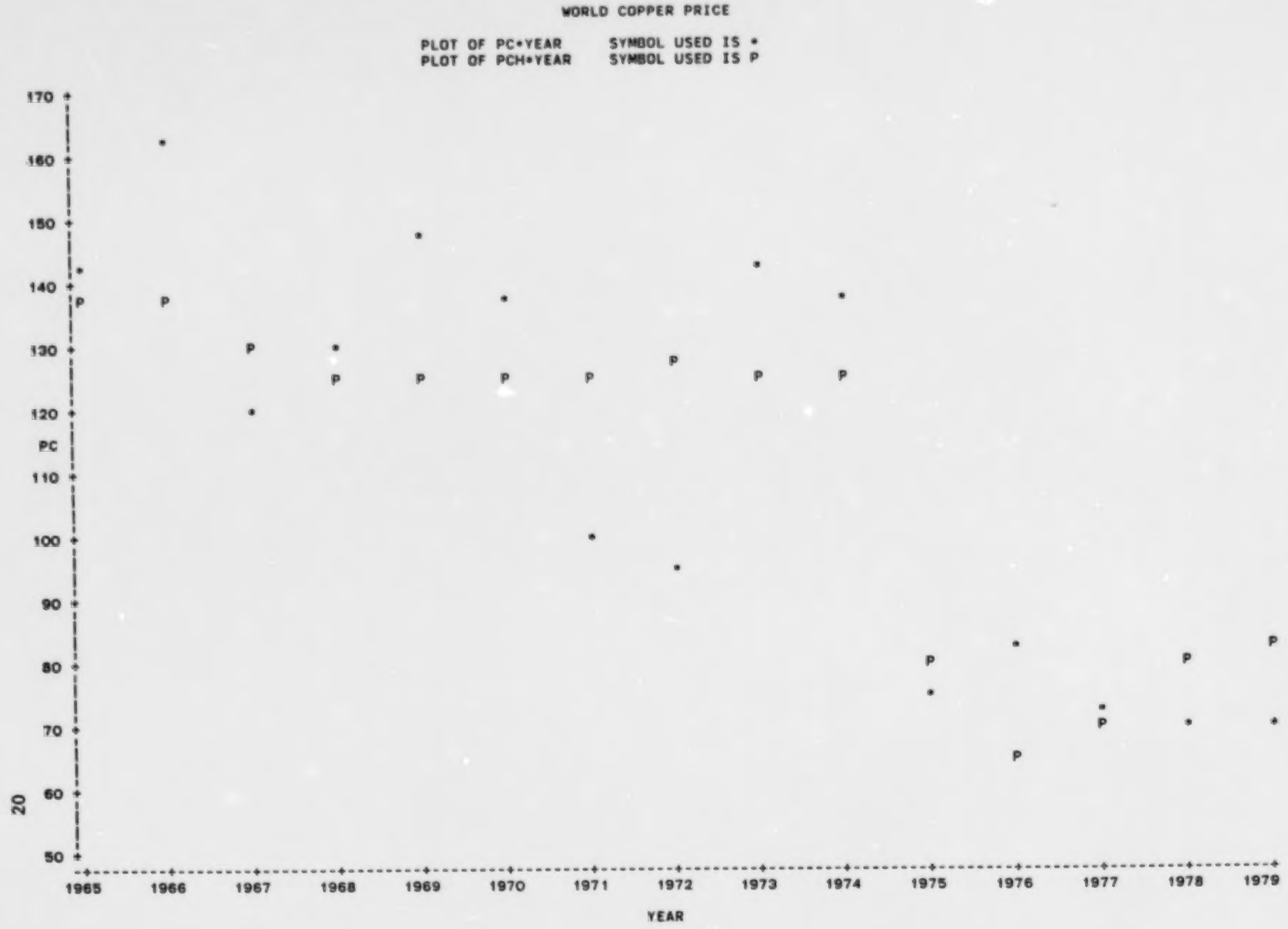
YEAR	CCCP	CCP	CPNA	PNA	CPSA	PSA	CPAS	PAS	CPAF	PAF	CPEU	PEU
1965	1104.0	1082.02	1687.0	1774.40	842.6	872.86	250.1	252.826	1121.9	1109.18	86.9	97.481
1966	1159.7	1126.04	1755.6	1910.60	914.3	857.44	263.3	274.991	1140.6	1158.90	85.5	104.201
1967	1227.5	1178.31	1421.9	1968.91	929.7	864.70	277.8	298.984	1182.2	1195.96	90.0	111.143
1968	1263.2	1236.71	1667.3	2076.67	954.4	896.90	306.3	326.511	1206.2	1228.66	98.7	120.002
1969	1303.7	1303.84	1921.2	2103.22	971.4	939.24	327.4	348.724	1284.8	1257.64	115.7	127.729
1970	1351.6	1367.12	2170.3	2072.92	991.8	982.30	353.8	364.859	1295.1	1283.89	114.8	133.608
1971	1413.0	1438.45	2035.4	2128.13	999.0	1025.44	385.2	385.366	1305.7	1310.59	136.0	141.756
1972	1506.7	1510.07	2230.0	2155.94	1032.3	1068.61	401.1	404.966	1418.2	1334.57	150.9	150.171
1973	1613.7	1579.83	2382.4	2311.36	1033.4	1112.26	433.3	428.643	1494.6	1350.95	182.4	159.304
1974	1660.1	1658.87	2270.2	2222.23	1210.8	1159.03	455.1	441.068	1499.8	1357.92	168.7	162.676
1975	1806.7	1744.04	2016.0	1795.79	1085.3	1188.25	452.1	436.133	1462.3	1330.04	180.8	158.477
1976	1873.9	1830.73	2187.5	1857.47	1326.4	1274.52	482.1	452.527	1471.6	1315.30	178.1	162.771
1977	1952.6	1920.90	2123.8	1936.51	1483.1	1369.36	508.7	467.874	1472.8	1309.34	182.4	167.461
1978	2009.4	2006.63	2017.0	1823.09	1506.4	1441.77	477.4	470.884	1371.0	1305.77	176.9	168.475
1979	2073.7	2095.55	1779.9	1676.96	1577.3	1499.27	509.9	469.964	1287.3	1305.32	169.1	168.776

YEAR	CPOC	POC	CPCP	PCP	CCWRLD	CWRLD	CPWRLD	PWRLD	CSCR	SCR	PC	PCH
1965	91.8	107.244	799.1	850.64	6075.2	6036.97	4879.4	5064.62	902.5	868.28	142.503	138.185
1966	111.3	108.178	857.8	927.36	6312.7	6015.38	5128.4	5341.66	1013.1	913.96	163.376	138.682
1967	91.8	108.530	966.3	1003.70	6056.8	6019.58	4959.7	5551.92	932.2	929.20	120.770	129.722
1968	109.6	109.585	1013.5	1075.61	6375.9	6339.31	5356.0	5833.93	1074.5	934.91	129.038	124.731
1969	130.8	150.072	1093.4	1145.04	6974.3	6640.99	5844.7	6071.65	1118.8	969.81	146.530	124.285
1970	157.8	156.447	1206.0	1214.02	7098.5	6792.66	6289.6	6208.04	1150.5	974.81	136.700	124.967
1971	177.3	158.719	1315.2	1283.01	7071.7	7161.28	6353.8	6433.01	959.5	1000.20	99.798	126.196
1972	309.8	307.646	1391.6	1352.18	7688.3	7557.78	6933.9	6774.08	986.0	1040.82	96.030	127.003
1973	403.2	394.277	1450.3	1421.27	8456.3	8031.29	7379.6	7178.05	1058.5	1111.43	141.451	125.951
1974	435.4	406.401	1485.9	1489.42	8011.5	7999.62	7525.9	7238.74	1160.2	1132.23	137.075	124.281
1975	391.5	406.071	1574.3	1556.39	7136.2	7283.50	7162.3	6871.16	881.9	949.86	75.555	80.847
1976	395.0	404.984	1637.8	1604.46	8203.9	7944.26	7678.5	7072.02	945.7	903.04	82.349	63.809
1977	403.9	409.444	1619.8	1646.19	8693.8	8892.27	7794.5	7306.18	923.1	979.88	72.111	70.495
1978	420.7	414.493	1702.9	1692.08	9144.1	9424.18	7672.3	7316.55	1012.1	1062.87	69.570	79.061
1979	408.2	417.640	1738.9	1742.57	9488.1	9780.92	7470.6	7280.49	1147.6	1148.44	70.799	81.413


WORLD COPPER PRIMARY PRODUCTION
PLOT OF CPWRLD*YEAR SYMBOL USED IS *
PLOT OF PWRLD*YEAR SYMBOL USED IS P
8100
7800
7500
7200
6900
6600
CPWRLD
6300
6000
5700
5400
5100
4800
4500
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR


WORLD COPPER SECONDARY PRODUCTION
PLOT OF CSCR*YEAR SYMBOL USED IS *
PLOT OF SCR*YEAR SYMBOL USED IS P
1200
1170
1140
1110
1080
1050
CSCR
1020
990
960
930
900
870
840
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR


WORLD COPPER CONSUMPTION
PLOT OF CCWRLD*YEAR SYMBOL USED IS *
PLOT OF CWRLD*YEAR SYMBOL USED IS P
10000
9500
9000
8500
CCWRLD
8000
7500
7000
6500
6000
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR


WORLD COPPER PRICE
PLOT OF PC*YEAR SYMBOL USED IS *
PLOT OF PCH*YEAR SYMBOL USED IS P
170
160
150
140
130
120
PC
110
100
90
80
70
60
50
20
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR

EVALUATION OF IN-SAMPLE PREDICTIONS -- COPPER

FUNCTION	ME	MPE	RMSE	RMSPE
CNA	-42.324	-0.017932	152.441	0.068475
CSA	0.945	0.016413	18.976	0.103630
CAS	0.593	0.011476	74.870	0.095641
CAF	4.093	0.123915	10.717	0.235019
CEU	-3.804	-0.002209	106.848	0.044589
COC	-1.294	-0.010688	7.093	0.059458
CCP	-16.026	-0.010978	30.623	0.020489
PNA	9.914	0.018623	231.401	0.138881
PSA	-20.418	-0.014484	63.357	0.054862
PAS	-3.952	-0.000431	20.405	0.049268
PAF	-57.337	-0.038799	90.575	0.061809
PEU	1.142	0.039549	15.257	0.129831
POC	1.442	0.023011	13.272	0.082868
PCP	10.077	0.013955	37.583	0.037351
SCR	-23.097	-0.019101	83.285	0.077975
CWRLD	-57.821	-0.009259	230.325	0.029760
PWRLD	-59.138	-0.001073	339.188	0.054509
PRICE	-1.602	0.007640	16.323	0.153336

Simulation Equations

As a result of the in-sample predictions performed, the equations used in the final simulation model are as displayed in the following tables.

SIMULATION EQUATIONS - PRIMARY PRODUCTION - COPPER

VARIABLE	NA	SA	AS	AF	EU	OC	CP
CONSTANT	-1618.7431	138.9997	126.3457	-124.6510	-10.4089	307.2846	-302.0119
PC	1.7507	1.1722	.	2.0266	.	.	.
PCLAG	8.0598	-2.9267	0.7445	-0.6906	0.3425	. .	1.0004
PCLAG2	.	.	.	.	.	.	.
ROWSLAG	0.8980	.	0.0303	-0.0297	.	0.0011	.
D	0.4173	.	0.0253	. .	0.0106	0.0024	.
DLAG	-0.4148	.	-0.0344	.	-0.0108	0.0031	.
DLAG2	.	.	.	.	.	.	.
T	13.3183	2.5541	-2.8689	3.8813	.	.	5.9124
R	.	.	.	.	.	.	.
RLAG	.	.	.	.	.	.	.
PASTPROD	-0.0886	0.0202	0.0134	.	.	.	-0.0009
LAGPROD	0.5139	0.5079	0.6643	0.9612	0.9811	0.1197	0.9256

SIMULATION EQUATIONS - SECONDARY PRODUCTION - COPPER

VARIABLE	NA	SA	AS	EU	OC
CONSTANT	-53.3241	-28.3050	5.3962	-89.9339	-17.8776
PC	2.6029	0.3127	0.5242	3.0153	0.0083
PCLAG	-2.7875	0.1142	-0.2841	-0.1230	0.0600
PCLAG2	.	.	.	.	0.3805
D	0.0614	0.1205	0.0559	0.0697	0.3343
DLAG	0.0441	-0.1214	0.0216	-0.0529	0.2087
DLAG2	-0.0123	0.0566	-0.0126	0.0660	-0.2909
DLAG3	.	.	.	.	-0.0175
LAGSCR	0.6844	0.8098	0.2315	0.4694	.

SIMULATION EQUATIONS - CONSUMPTION - COPPER

VARIABLE	NA	SA	AS	AF	EU	OC	CP
CONSTANT	86.0780	-242.9372	-514.7057	-32.4033	27.4124	-25.3896	38.6775
PCPA	.	.	.	.	.	.	.
PCPALAG	.	-0.5409	-1.1146	.	-4.6775	-0.1386	.
PCPALAG2	-0.3211	.	.	.	.	.	.
INVENLAG	.	0.0063	.	.	0.0061	-0.0033	0.0074
Y	5550.4414	1115.7820	1874.5602	.	.	443.3079	.
YLAG	-4697.8888	-697.0972	-561.2801	47.4345	1679.5866	-384.6115	272.5126
KGLAG	.	82.3715	1367.6544	.	2238.5562	62.9920	.
MGLAG	.	.	.	.	-6.7000	0.1095	.
LAGCON	0.4945	0.1055	-0.1079	0.8454	0.3122	0.5935	0.8277

SIMULATION EQUATIONS - PRICE - COPPER

VARIABLE	WORLD
CONSTANT	31.7104
PCLAG	0.3950
PCLAG2	-0.2602
INVENLAG	-0.0016
SUPPLY	.
T	.
Y	.
R	-0.4522
PA	.
PALAG	.
PALAG2	.

-ALUMINUM-

Data

The updated data for aluminum are displayed in the following tables. Note again that the prices are expressed in 1967 U.S. dollars and that any revisions reflect the most currently available data.

ALUMINUM: PRIMARY PRODUCTION (7-1)

YEAR	APNA	APSA	APAS	APAF	APEU	APOC	APCP
1947	790.0	0.0	6.0	0.0	157.3	0.0	96.5
1948	898.6	0.0	12.9	0.0	201.4	0.0	111.1
1949	882.7	0.0	26.0	0.0	215.2	0.0	131.7
1950	1011.9	0.0	30.3	0.0	243.8	0.0	219.9
1951	1164.8	0.4	43.7	0.0	358.8	0.0	239.9
1952	1303.7	1.1	50.2	0.0	414.9	0.0	262.4
1953	1630.9	1.2	54.2	0.0	446.5	0.0	321.1
1954	1833.8	1.5	65.2	0.0	489.1	0.0	430.8
1955	1971.7	1.7	72.0	0.0	532.3	1.3	525.7
1956	2085.8	6.3	81.4	0.0	597.1	9.3	557.7
1957	2000.2	8.9	84.1	7.6	622.4	10.8	653.2
1958	1999.3	11.9	101.6	31.9	636.7	11.1	734.2
1959	2316.4	18.1	125.0	42.3	705.5	11.6	802.7
1960	2518.8	16.5	159.7	43.9	834.8	11.8	890.7
1961	2328.6	18.6	181.1	45.6	903.7	13.4	1026.1
1962	2543.7	35.2	217.6	52.2	978.2	16.5	1078.8
1963	2750.4	26.4	291.0	52.9	1054.8	41.9	1102.5
1964	3080.4	44.4	341.4	51.5	1167.9	80.0	1211.4
1965	3242.2	63.1	376.5	50.5	1240.8	87.8	1439.7
1966	3500.2	75.5	436.0	48.2	1398.3	92.0	1568.5
1967	3839.7	84.7	491.1	98.8	1508.1	92.8	1727.9
1968	3841.2	117.9	618.5	155.9	1703.5	97.4	2004.4
1969	4419.6	141.6	726.2	159.8	1816.6	126.4	1939.1
1970	4569.6	167.4	932.8	165.4	1967.4	205.6	2113.8
1971	4563.0	224.1	1119.7	191.2	2257.0	246.0	2217.0
1972	4646.9	209.4	1304.7	231.9	2445.4	293.5	2362.2
1973	5038.7	227.5	1439.1	249.1	2759.9	323.9	2509.1
1974	5472.3	253.9	1464.4	279.0	3149.9	329.4	2714.9
1975	4397.1	268.0	1406.0	273.0	3064.6	322.8	2796.9
1976	4484.9	317.2	1362.2	337.2	3151.6	372.1	2859.1
1977	5090.6	359.1	1612.9	368.3	3292.8	392.7	2862.3
1978	5406.4	419.6	1511.8	336.3	3346.7	414.5	2963.2
1979	5420.4	694.4	1454.3	400.7	3424.8	423.7	3000.1
1980	5728.1	823.5	1567.5	437.4	3597.3	459.7	3092.9

ALUMINUM: SECONDARY PRODUCTION (7-2)

YEAR	ASCRNA	ASCRSA	ASCRAS	ASCRAF	ASCREU	ASCROC
1947	.	.	.	.	.	.
1948	264.4	1.0	4.4	0.0	172.6	0.3
1949	167.8	1.0	3.4	0.0	162.5	0.3
1950	226.1	1.0	5.6	0.4	196.3	0.4
1951	272.9	1.0	6.8	0.5	193.5	0.4
1952	283.8	1.0	10.1	0.5	187.5	0.4
1953	341.3	1.0	12.6	0.5	202.5	0.4
1954	270.1	1.5	15.4	0.8	234.8	0.4
1955	311.7	1.1	15.1	1.0	281.8	0.4
1956	314.7	1.6	18.1	1.0	275.3	0.5
1957	335.1	2.2	23.7	1.2	286.2	0.4
1958	269.4	2.1	28.4	2.1	313.2	3.4
1959	333.5	2.5	43.0	2.7	341.7	4.2
1960	307.2	3.0	57.0	2.7	379.5	4.5
1961	453.7	4.5	78.8	2.7	387.4	4.8
1962	543.8	4.5	81.5	3.0	424.1	5.0
1963	614.6	4.5	104.5	3.0	473.5	5.0
1964	665.7	5.0	119.8	3.0	526.9	7.5
1965	795.7	6.1	138.7	5.0	556.6	8.0
1966	860.5	17.6	158.2	6.5	601.8	12.8
1967	852.7	17.8	202.1	6.5	606.1	14.4
1968	967.3	20.2	248.2	7.0	686.2	17.4
1969	1099.1	26.1	301.4	7.0	802.9	19.3
1970	968.9	26.6	344.2	7.0	814.0	19.9
1971	1037.5	28.9	373.4	8.0	826.7	21.9
1972	1053.3	41.0	436.9	8.5	886.4	21.5
1973	1163.5	46.7	571.1	8.5	993.6	30.6
1974	1192.9	55.7	553.9	9.5	1029.8	38.4
1975	1160.2	49.4	465.3	10.0	886.4	26.5
1976	1374.5	52.0	561.6	9.8	1078.8	34.8
1977	1504.3	54.0	613.2	15.6	1166.4	26.4
1978	1592.5	82.5	674.6	16.2	1179.3	25.9
1979	1690.8	90.7	790.6	16.4	1205.8	32.5
1980	1615.0	87.1	829.6	16.5	1210.3	37.0

ALUMINUM: CONSUMPTION (7-3)

YEAR	ACNA	ACSA	ACAS	ACAF	ACEU	ACOC	ACCP
1947	609.9	13.1	10.7	1.0	346.0	4.5	108.6
1948	718.4	12.6	13.7	1.0	363.3	5.0	132.1
1949	649.1	14.4	19.5	1.0	364.4	7.6	152.7
1950	882.1	21.9	27.6	2.0	396.8	6.3	244.9
1951	955.3	22.2	41.4	2.5	517.3	11.8	257.1
1952	1048.1	12.5	41.1	3.0	568.2	8.5	273.4
1953	1457.9	21.1	48.4	3.5	518.0	8.1	329.8
1954	1332.9	37.3	60.6	5.0	648.2	11.2	445.1
1955	1664.8	30.2	70.6	6.5	806.6	20.0	505.7
1956	1692.7	43.0	83.8	6.1	842.6	20.0	533.1
1957	1385.1	45.4	98.0	8.5	802.3	18.9	620.1
1958	1426.4	56.9	109.3	9.2	835.6	26.8	651.7
1959	1925.8	52.0	151.4	10.3	1012.6	33.4	776.6
1960	1641.9	62.5	198.4	14.0	1240.1	39.4	891.1
1961	1900.4	85.4	239.6	15.4	1155.9	31.9	998.3
1962	2196.2	107.0	250.4	18.7	1216.2	47.0	1045.0
1963	2478.1	83.2	319.8	21.3	1319.9	54.0	1081.5
1964	2691.3	96.8	370.4	27.4	1486.7	72.0	1154.6
1965	3020.9	126.3	407.1	27.9	1510.8	75.7	1351.6
1966	3489.3	150.0	556.5	43.4	1744.8	83.8	1450.9
1967	3309.3	153.3	700.5	35.8	1733.1	92.6	1622.1
1968	3790.0	167.3	851.6	45.2	2008.6	110.8	1730.8
1969	3917.8	195.9	1034.4	61.0	2343.9	116.8	1797.7
1970	3708.3	201.4	1211.0	70.6	2506.3	137.6	1960.9
1971	4185.5	238.4	1307.2	91.3	2421.0	153.6	2054.8
1972	4577.8	303.0	1546.8	97.6	2703.1	132.1	2183.0
1973	5377.2	338.3	1978.3	110.1	3100.4	175.1	2304.9
1974	5485.5	399.1	1704.0	115.9	3264.0	202.6	2472.5
1975	3551.0	402.5	1586.6	113.6	2678.9	153.3	2506.7
1976	4812.7	396.7	2113.7	117.9	3330.5	186.5	2646.1
1977	5088.4	434.7	2032.1	129.4	3340.6	193.5	2766.7
1978	5316.9	487.4	2329.6	133.3	3394.3	206.9	2870.4
1979	5357.7	550.4	2486.8	136.1	3669.4	223.0	2922.0
1980	4765.0	603.2	2368.0	179.1	3682.7	243.6	2892.8

ALUMINUM: WORLD PRODUCTION, CONSUMPTION, AND PRICES (7-4)

YEAR	APWRLD	ASCRWRLD	ACWRLD	PA	PC
1947	1049.8	.	1093.8	18.3007	30.7058
1948	1224.0	442.7	1246.1	17.7935	29.1160
1949	1255.6	335.0	1208.7	20.3304	27.5267
1950	1505.9	429.8	1581.6	20.4315	27.3233
1951	1807.6	475.1	1807.6	19.7585	30.0462
1952	2032.3	483.3	1954.8	20.7788	36.7206
1953	2453.9	559.3	2386.8	22.5458	36.5054
1954	2820.4	523.0	2540.3	23.0639	35.5850
1955	3104.7	611.1	3104.4	24.9260	49.8828
1956	3337.6	611.2	3221.3	26.4961	45.2650
1957	3387.2	648.8	2978.3	27.2412	29.3384
1958	3526.7	618.6	3115.9	26.2051	26.1726
1959	4021.6	727.6	3962.1	26.0949	31.4499
1960	4476.2	753.9	4087.4	27.3973	32.4862
1961	4517.1	931.9	4426.9	26.9397	30.3914
1962	4922.2	1061.9	4880.5	25.1846	30.9385
1963	5319.9	1205.1	5357.8	23.9397	30.9869
1964	5977.0	1327.9	5899.2	25.0697	46.2151
1965	6500.6	1510.1	6520.3	25.3696	60.4853
1966	7118.7	1657.4	7518.7	24.5491	69.3448
1967	7843.1	1699.6	7646.7	24.9780	51.2604
1968	8538.8	1946.3	8704.3	24.9590	54.7700
1969	9329.3	2255.8	9467.5	25.5174	62.1942
1970	10122.0	2180.6	9796.1	26.0109	58.0221
1971	10818.0	2296.4	10451.8	25.4609	42.3591
1972	11494.0	2447.6	11543.4	22.1738	40.7599
1973	12547.3	2814.0	13384.3	18.5598	60.0386
1974	13663.8	2880.2	13643.6	21.3198	58.1813
1975	12528.4	2597.8	10992.6	22.7479	32.0690
1976	12884.3	3111.5	13604.1	24.2301	34.9529
1977	13978.7	3379.9	13985.4	26.4361	30.6075
1978	14398.5	3571.0	14738.8	25.3583	29.5288
1979	14818.4	3826.8	15345.4	25.2101	30.0507
1980	15706.4	3795.5	14734.4	25.8898	36.9538

Estimation

As was the case with copper, several dummy variables were used in the estimation of the individual equations. In the price equation, we used dummies for the periods 1972-1973 and 1977 to account for price changes that the model was not able to explain.

For consumption, the recessionary impact of 1975-76 was dummied in both North America and Oceania. For Asia, we dummied 1974-75.

It was, however, with the primary production of aluminum that we experienced the most difficulty. In the case of Asia, we used a dummy variable for the period 1975-79 to reflect the lowered production level. In Africa, we dummied both the decline in production in 1964-66 and the decline in 1978. The most severe problems were with primary production from South America. We dummied the decline in production in 1972 and the increase to a higher level of production indicated in 1979 (and 1980). Additionally, for South America, we also used a dummy variable approach to alter the trend in production and the sensitivity to price after 1964*.

Finalizattion

The entire aluminum model is made up of 21 individual equations. Combining these, we performed in-sample predictions for the period 1965-79. Following are the actual and predicted values. (In this table, actual values are presented first and the prices are in 1979 U.S. dollars.) Next, we provide a plot of the actual and predicted world values for this period. (Actual values are identified with the symbol * and predicted values with

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*Specifically we set up a dummy for the period 1951-64 and then used the interaction between this dummy and price and lagged production.

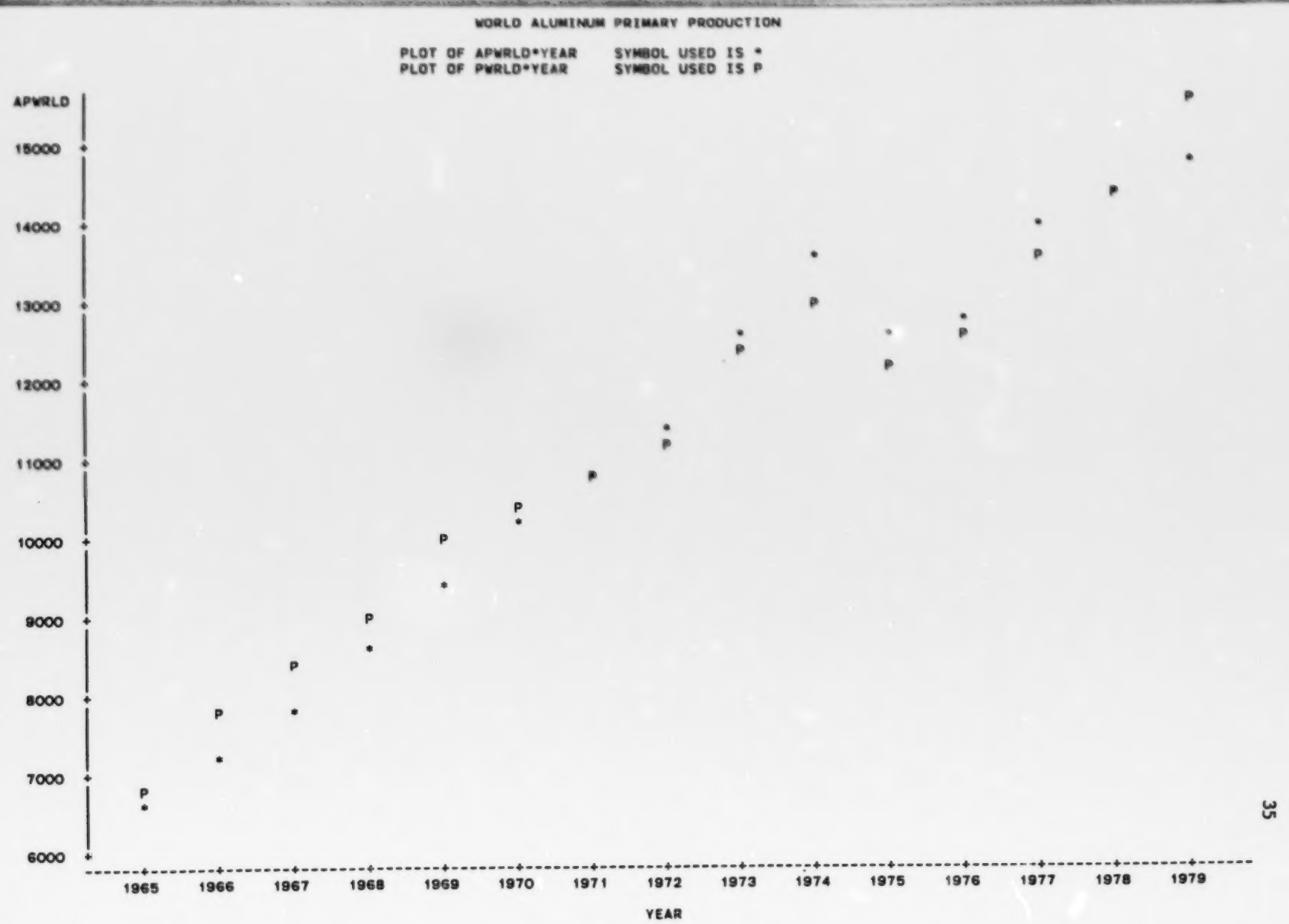
the symbol P.) To evaluate the in-sample predictions, we then present mean error, mean percentage error, root mean squared error, and root mean squared percentage error for the individual equations.

COMPARISON OF ACTUAL AND PREDICTED VALUES -- ALUMINUM

YEAR	ACNA	CNA	ACSA	CSA	ACAS	CAS	ACAF	CAF	ACEU	CEU	ACOC	COC
1965	3020.9	3210.53	126.3	131.361	407.1	540.79	27.9	37.475	1510.8	1654.77	75.7	79.914
1966	3489.3	3604.41	150.0	146.758	556.5	679.42	43.4	50.109	1744.8	1816.71	83.8	86.907
1967	3309.3	3369.10	153.3	153.054	700.5	764.52	35.8	41.609	1733.1	1858.42	92.6	94.046
1968	3790.0	3860.75	167.3	163.043	851.6	876.43	45.2	47.707	2008.6	2082.20	110.8	111.840
1969	3917.8	4078.76	195.9	199.656	1034.4	1036.22	61.0	56.967	2343.9	2362.59	116.8	127.490
1970	3708.3	3958.32	201.4	224.891	1211.0	1144.89	70.6	68.694	2506.3	2483.01	137.6	138.178
1971	4185.5	3837.58	238.4	240.440	1307.2	1254.22	91.3	75.156	2421.0	2405.86	153.6	144.368
1972	4577.8	4367.80	303.0	270.570	1546.8	1486.73	97.6	82.271	2703.1	2771.79	132.1	154.723
1973	5377.2	5182.67	338.3	326.258	1978.3	1771.53	110.1	91.365	3100.4	3178.84	175.1	178.049
1974	5485.5	4839.58	399.1	368.495	1704.0	1590.77	115.9	102.954	3264.0	3060.57	202.6	193.679
1975	3551.0	3897.53	402.5	382.251	1586.6	1494.87	113.6	105.285	2678.9	2739.03	153.3	163.575
1976	4812.7	4462.85	396.7	402.693	2113.7	2076.19	117.9	118.007	3330.5	3213.68	186.5	176.287
1977	5088.4	5074.05	434.7	450.634	2032.1	2173.71	129.4	125.487	3340.6	3241.03	193.5	192.841
1978	5316.9	5516.75	487.4	499.664	2329.6	2310.71	133.3	137.279	3394.3	3353.75	206.9	201.628
1979	5357.7	5793.96	550.4	556.960	2486.8	2548.22	136.1	140.529	3669.4	3652.73	223.0	213.205

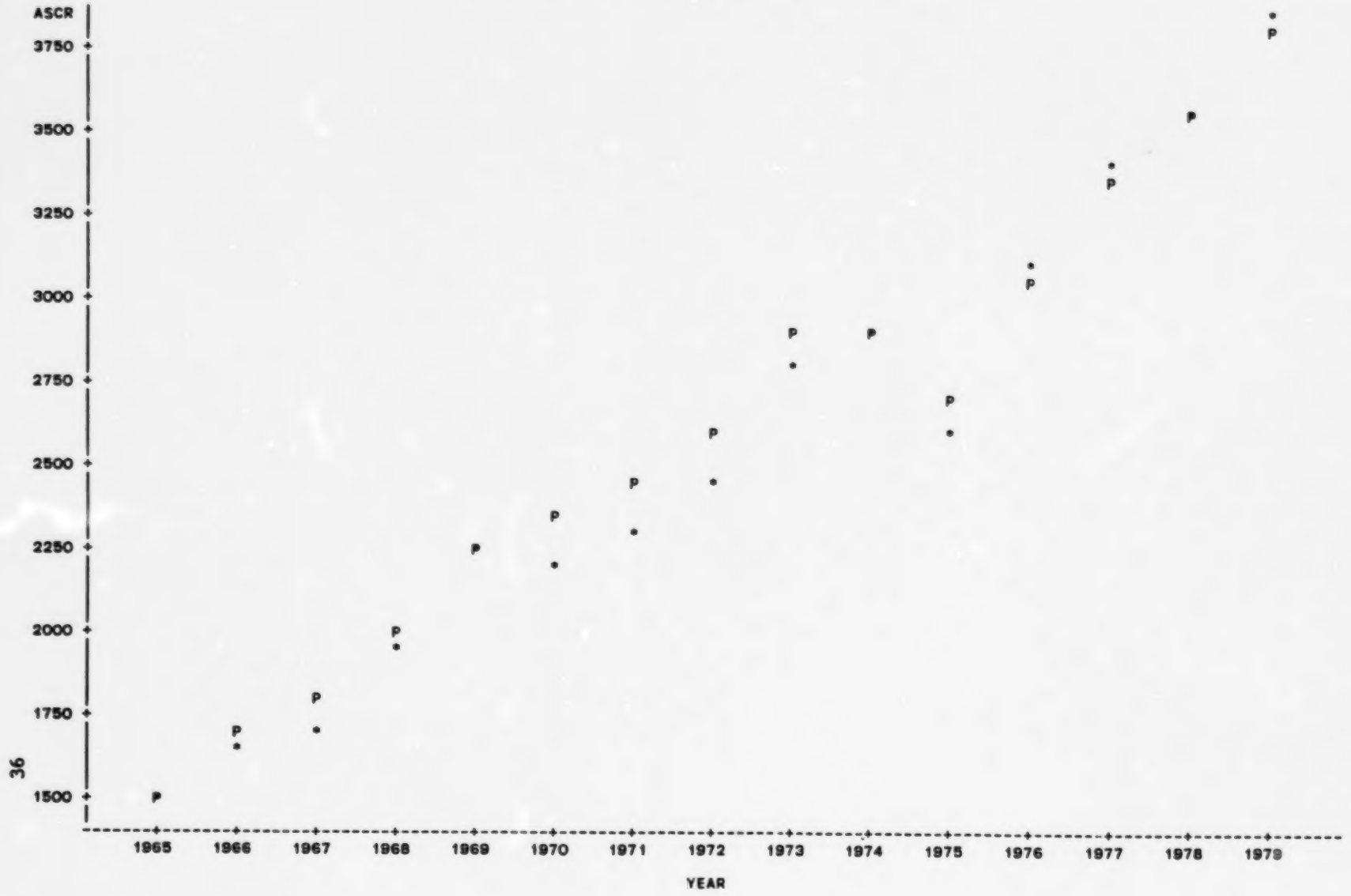
YEAR	ACCP	CCP	APNA	PNA	APSA	PSA	APAS	PAS	APAF	PAF	APEU	PEU
1965	1351.6	1273.67	3242.2	3469.08	63.1	63.895	376.5	421.78	50.5	48.739	1240.8	1326.10
1966	1450.9	1424.40	3500.2	3898.88	75.5	86.455	436.0	521.93	48.2	60.961	1398.3	1516.58
1967	1622.1	1550.36	3839.7	3929.43	84.7	111.653	491.1	625.33	98.8	99.738	1508.1	1667.83
1968	1730.8	1686.54	3841.2	4068.96	117.9	139.350	618.5	724.80	155.9	139.251	1703.5	1838.62
1969	1797.7	1796.08	4419.6	4375.29	141.6	169.924	726.2	838.41	159.8	176.663	1816.6	2031.97
1970	1960.9	1938.79	4569.6	4459.96	167.4	203.683	932.8	954.67	165.4	205.452	1967.4	2200.68
1971	2054.8	2043.00	4563.0	4272.58	224.1	240.613	1119.7	1059.40	191.2	224.826	2257.0	2318.33
1972	2183.0	2128.29	4646.9	4340.75	209.4	228.028	1304.7	1163.02	231.9	254.752	2445.4	2459.99
1973	2304.9	2278.38	5038.7	4976.92	227.5	251.642	1439.1	1286.54	249.1	286.829	2759.9	2721.16
1974	2472.5	2436.75	5472.3	5106.23	253.9	278.732	1464.4	1414.09	279.0	293.024	3149.9	2944.36
1975	2506.7	2546.46	4397.1	4301.01	268.0	313.602	1406.0	1368.19	273.0	285.519	3064.6	2977.43
1976	2646.1	2669.38	4484.9	4427.51	317.2	355.610	1362.2	1329.08	337.2	311.307	3151.6	3051.60
1977	2766.7	2759.42	5090.6	5132.69	359.1	407.301	1612.9	1345.02	368.3	344.232	3292.8	3175.19
1978	2870.4	2875.40	5406.4	5628.96	419.6	466.660	1511.8	1392.74	336.3	317.538	3346.7	3300.53
1979	2922.0	2966.21	5420.4	6053.05	694.4	745.892	1454.3	1462.05	400.7	382.033	3424.8	3454.83

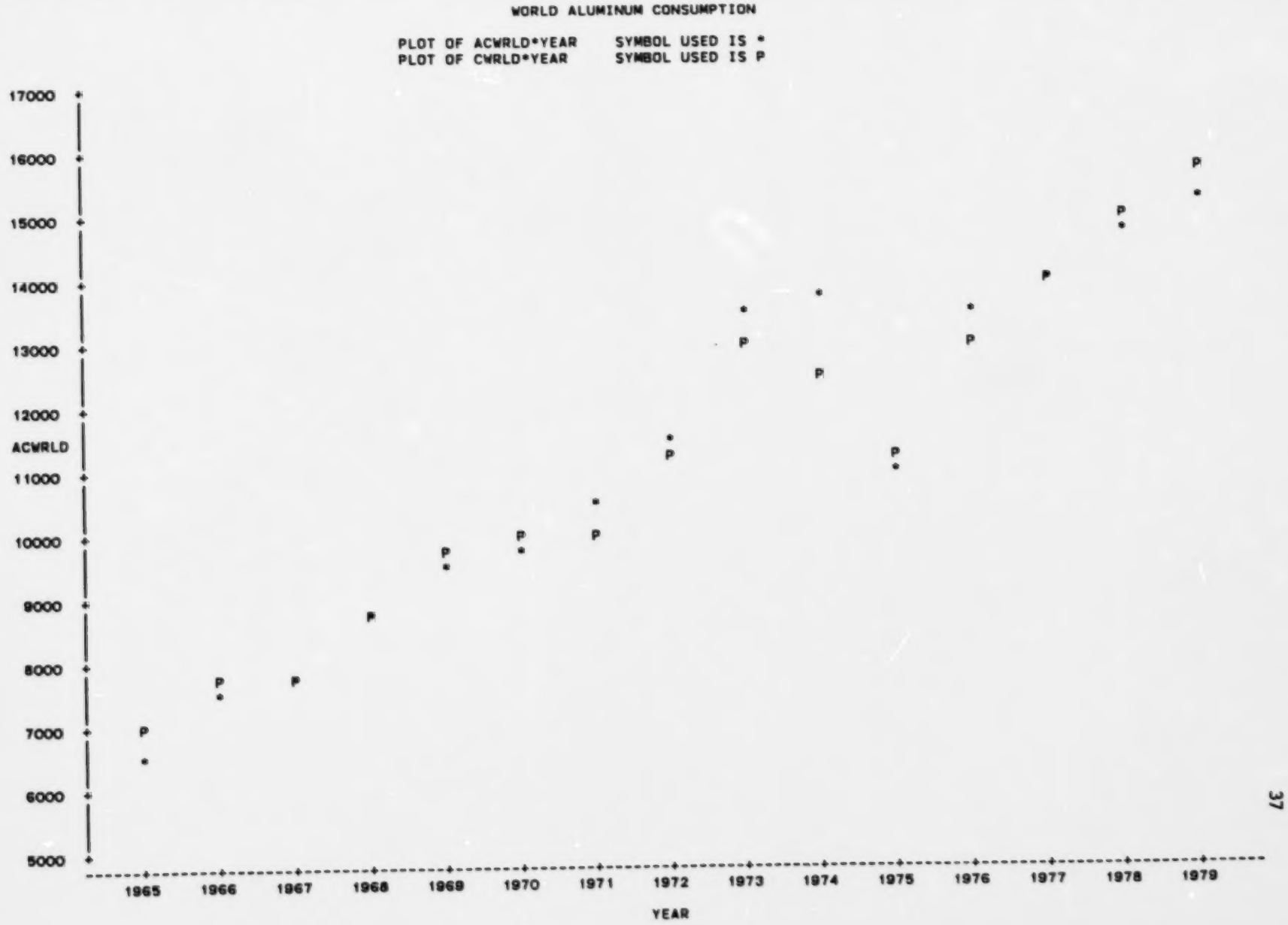
YEAR	APOC	POC	APCP	PCP	ACWRLD	CWRLD	APWRLD	PWRLD	ASCR	SCR	PA	PAH
1965	87.8	96.940	1439.7	1453.65	6520.3	6928.5	6500.6	6880.2	1510.1	1519.12	59.7707	60.2307
1966	92.0	125.402	1568.5	1646.52	7518.7	7808.7	7118.7	7856.7	1657.4	1719.28	57.8377	60.9365
1967	92.8	147.143	1727.9	1795.71	7646.7	7831.1	7843.1	8376.8	1699.6	1799.22	58.8482	60.8832
1968	97.4	180.907	2004.4	1960.65	8704.3	8828.5	8538.8	9052.5	1946.3	2012.15	58.8035	60.6682
1969	126.4	211.717	1939.1	2097.29	9467.5	9658.8	9329.3	9901.3	2255.8	2233.51	60.1189	60.6840
1970	205.6	239.777	2113.8	2227.38	9796.1	9956.8	10122.0	10491.6	2180.6	2372.31	61.2816	60.5837
1971	246.0	263.509	2217.0	2327.10	10451.8	10000.6	10818.0	10706.3	2296.4	2430.53	59.9860	60.0736
1972	293.5	285.489	2362.2	2386.02	11543.4	11262.2	11494.0	11118.0	2447.6	2619.63	52.2415	50.8021
1973	323.9	294.974	2509.1	2502.36	13384.3	13007.1	12547.3	12320.4	2814.0	2895.16	43.7268	44.0432
1974	329.4	292.705	2714.9	2666.11	13643.6	12592.8	13663.8	12995.2	2880.2	2889.69	50.2294	48.8330
1975	322.8	294.301	2796.8	2741.47	10992.6	11329.0	12528.4	12281.5	2597.8	2701.14	53.5939	52.8417
1976	372.1	326.574	2859.1	2788.83	13604.1	13119.1	12884.3	12590.5	3111.5	3060.76	57.0860	55.3058
1977	392.7	349.881	2862.3	2815.64	13985.4	14017.2	13978.7	13569.9	3379.9	3343.36	62.2836	60.9402
1978	414.5	378.351	2963.2	2915.06	14738.8	14895.2	14398.5	14399.8	3571.0	3533.24	59.7442	60.8859
1979	423.7	400.450	3000.1	3046.78	15345.4	15871.8	14818.4	15545.1	3826.8	3807.23	59.3950	59.9915

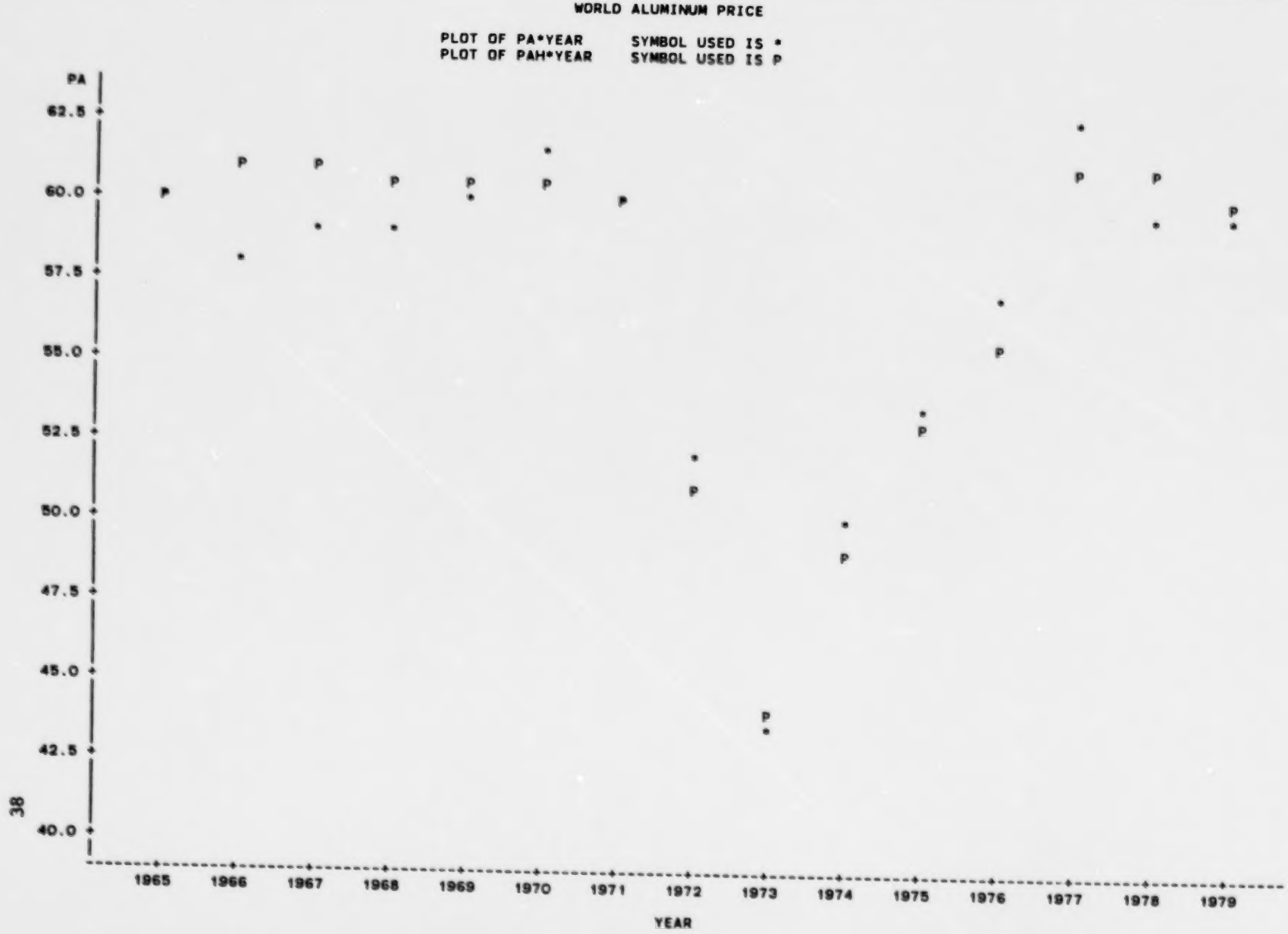

WORLD ALUMINUM PRIMARY PRODUCTION
PLOT OF APWRLD*YEAR SYMBOL USED IS *
PLOT OF PWRLD*YEAR SYMBOL USED IS P
APWRLD
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR

WORLD ALUMINUM SECONDARY PRODUCTION

PLOT OF ASCR*YEAR SYMBOL USED IS *
PLOT OF SCR*YEAR SYMBOL USED IS P




WORLD ALUMINUM CONSUMPTION
PLOT OF ACWRLD*YEAR SYMBOL USED IS *
PLOT OF CWRLD*YEAR SYMBOL USED IS P
17000
16000
15000
14000
13000
12000
ACWRLD
11000
10000
9000
8000
7000
6000
5000
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR


WORLD ALUMINUM PRICE
PLOT OF PA*YEAR SYMBOL USED IS *
PLOT OF PAH*YEAR SYMBOL USED IS P
PA
62.5
60.0
57.5
55.0
52.5
50.0
47.5
45.0
42.5
40.0
38
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR

EVALUATION OF IN-SAMPLE PREDICTIONS -- ALUMINUM

FUNCTION	ME	MPE	RMSE	RMSPE
CNA	4.489	0.006628	287.481	0.062719
CSA	-1.865	-0.002999	15.601	0.051800
CAS	-6.465	0.025159	95.939	0.114456
CAF	-3.214	-0.002233	9.419	0.137058
CEU	8.353	0.011157	92.915	0.041228
COC	0.855	0.015792	8.811	0.062420
CCP	-17.863	-0.011717	39.699	0.023044
PNA	33.901	0.010356	266.372	0.058682
PSA	29.309	0.136865	32.649	0.154152
PAS	-23.276	0.023133	112.504	0.127598
PAF	5.704	0.050516	22.675	0.125495
PEU	30.520	0.028575	128.590	0.066380
POC	4.501	0.142182	43.736	0.344027
PCP	19.491	0.012657	73.267	0.035397
SCR	50.756	0.024773	91.682	0.040935
CWRLD	-15.719	0.003038	411.724	0.036107
PWRLD	100.139	0.017029	461.587	0.048693
PRICE	0.184	0.002752	1.404	0.024545

Simulation Equations

On the basis of our in-sample predictions and on some arbitrary future simulations, the equations used in the final simulation model are as displayed in the following table.

A Warning to the User

As we noted earlier, we encountered a substantial amount of difficulty in dealing with primary production--especially in the case of South America. (See the root mean squared percentage errors for these equations.) Hence, we suggest that the user be cautious when evaluating aluminum predictions. This is most evident for South America. The historical data exhibited a very strong trend. Even after numerous adjustments and reestimations, the coefficient on lagged production (LAGPROD) was 1.1065. When we ran future simulations, we felt that the predictions for South America production were too high. (And, given the market structure used, production in North America was too low). The user may then want to adjust the projected production for South America downward. This is easily done in the simulation model using the procedure described on pages 71 and 97 of World Mineral Markets, Stage III.

SIMULATION EQUATIONS - PRIMARY PRODUCTION - ALUMINUM

VARIABLE	NA	SA	AS	AF	EU	OC	CP
CONSTANT	-663.2388	-53.7385	-264.4258	-132.2034	273.4323	-0.8472	-2096.9053
PA	37.8917	1.7751	.	.	4.0710	2.2785	14.8542
PALAG	4.7208	0.9225	2.4897	3.1268	-10.5661	1.4716	-15.2164
PALAG2	.	.	.	.	.	.	.
ROWSLAG	-0.3080	.	.	.	0.0124	0.0163	0.1405
D	0.3958	.	0.0117	0.0142	0.0704	0.0166	0.0509
DLAG	0.2280	.	0.0201	.	0.0187	-0.0118	-0.0462
DLAG2	.	.	.	.	.	.	.
T	.	.	.	.	-3.7262	-3.7040	38.4844
R	.	.	.	.	.	1.3432	.
RLAG	.	.	.	.	.	7.4990	.
PASTPROD	-0.0288	.	.	.	-0.0089	-0.0285	-0.0176
LAGPROD	0.2064	1.1065	0.8458	0.6560	0.7464	0.7664	0.3664

SIMULATION EQUATIONS - SECONDARY PRODUCTION - ALUMINUM

VARIABLE	NA	SA	AS	AF	EU	OC
CONSTANT	-258.2915	-4.5990	-48.3004	-5.6969	-57.8215	-0.9870
PA	20.7167	.	.	0.2811	.	.
PALAG	-11.9207	.	.	-0.0364	2.9541	.
PALAG2	.	.	1.9015	.	.	.
D	0.1217	0.2071	0.2158	0.0438	0.2723	0.2048
DLAG	-0.0864	-0.0914	-0.0432	-0.0199	-0.0780	-0.1513
DLAG2	0.0223	-0.0276	-0.1318	0.0170	-0.0115	0.0517
DLAG3	.	.	0.0281	.	.	-0.0463
LAGSCR	0.8704	0.4244	0.7860	0.6536	0.4438	0.6231

SIMULATION EQUATIONS - CONSUMPTION - ALUMINUM

VARIABLE	NA	SA	AS	AF	EU	OC	CP
CONSTANT	-4183.6334	-309.3940	-622.5389	-47.3615	-819.1557	-250.5117	-98.8737
PAPC	-19.1363	-0.5884	.	-0.1440	-5.4866	.	-1.3719
PAPCLAG	7.4081	0.4252	.	0.0162	3.6991	.	-1.0510
PAPCLAG2	.	.	.	.	.	.	.
INVENLAG	.	-0.0115	.	-0.0056	-0.0060	-0.0003	0.0136
Y	7560.1738	217.7530	2276.5556	82.2036	6471.2831	249.4954	1053.3835
YLAG	.	222.9760	-1400.8701	-25.4140	-4724.1701	136.4700	-441.7015
KGLAG	.	85.4163	1698.4108	121.9820	-702.5101	-17.9442	.
MGLAG	.	.	.	.	9.7779	0.8435	.
LAGCON	0.0572	0.4577	0.6405	0.7731	0.5569	.	0.7289

SIMULATION EQUATIONS - PRICE - ALUMINUM

VARIABLE	WORLD
CONSTANT	8.7083
PALAG	0.7973
PALAG2	-0.1468
INVENLAG	-0.0001
SUPPLY	.
T	.
Y	.
R	.
PC	0.0087
PCLAG	.
PCLAG2	.

-NICKEL-

We were particularly concerned with the nickel market. As we noted in World Mineral Markets, Stage II, the model estimated in our previous analyses did not prove to be very satisfactory in the sense of future simulations (especially for North American production). In that project we resorted to the relatively ad hoc device of assuming that, in the future, the nickel market will behave like the copper market -- we assumed a change in structure.

In this project we concentrated on the apparant change in structure of the nickel market. Specifically, we felt that the structure changed from one characterized by dominant firm price leadership to a more competitive structure. Using economic theory, such a change would be reflected in the supply behavior of the dominant firm -- or, in our case, the dominant country group.* Hence, our estimations were designed so as to identify this change in structure.

Data

The updated data for nickel are displayed in the following tables. Again, prices are in 1967 U.S. dollars. Also note that the nickel scrap data reflect only U.S. non-ferrous scrap recovery.

Since we will concentrate on primary production, we have also provided a plot of the percentage shares of world production. In this plot, North American primary production as a percentage of total world production is denoted by the symbol N, South America by S and so on.

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*See, for instance, C.E. Ferguson, Microeconomic Theory, Homewood, Ill.: R.D. Irwin, 1972.

NICKEL: PRIMARY PRODUCTION (8-1)

YEAR	NPNA	NPSA	NPAS	NPAF	NPEU	NPOC	NPCP
1947	107.6	2.6	0.0	0.6	0.5	2.9	16.2
1948	119.5	0.8	0.0	0.6	0.2	3.6	17.8
1949	116.7	0.7	0.0	0.6	0.1	2.5	25.4
1950	112.2	0.8	0.0	0.9	0.4	4.3	29.6
1951	125.1	0.7	0.6	1.2	0.1	6.7	33.7
1952	127.5	8.7	0.1	1.5	0.4	10.7	37.8
1953	131.0	12.7	0.1	1.8	0.2	17.1	41.0
1954	146.7	13.2	0.1	2.0	0.1	13.7	43.0
1955	162.2	13.9	0.2	2.0	0.1	24.7	45.1
1956	168.0	14.7	0.1	3.5	0.8	29.5	48.5
1957	179.6	20.3	0.1	3.4	1.1	43.3	51.6
1958	137.3	18.0	0.4	1.4	0.4	14.2	54.9
1959	179.7	17.9	0.1	2.8	0.3	32.8	55.0
1960	206.0	14.6	0.2	3.2	2.1	53.0	60.3
1961	221.5	16.6	0.5	2.9	2.0	54.0	62.8
1962	225.2	20.1	0.5	3.8	2.4	34.5	65.0
1963	207.3	1.0	1.1	3.6	2.9	44.5	102.7
1964	218.4	1.1	1.2	4.6	3.2	58.2	105.3
1965	247.4	1.1	2.4	6.3	3.0	61.2	110.2
1966	214.9	1.1	2.6	6.5	3.0	67.8	119.7
1967	338.9	1.1	3.9	6.9	5.9	84.8	134.5
1968	253.5	1.1	5.7	9.0	7.4	120.8	147.6
1969	208.1	1.3	5.0	15.0	9.2	128.0	147.5
1970	291.6	3.0	10.9	20.3	13.6	168.3	155.5
1971	281.2	3.5	15.0	22.3	14.6	186.4	155.8
1972	249.2	20.8	14.5	22.0	17.0	143.6	156.2
1973	261.6	34.2	16.3	31.1	20.3	156.0	154.6
1974	281.9	34.0	16.4	42.8	21.8	182.9	163.4
1975	255.2	30.1	24.2	36.5	20.9	209.3	172.9
1976	252.7	29.8	29.1	49.7	23.2	202.2	178.0
1977	245.1	29.0	52.9	50.6	15.9	202.7	183.4
1978	140.1	19.7	59.8	54.4	19.8	149.6	189.0
1979	138.6	34.3	69.2	61.0	21.0	152.6	191.2
1980	207.7	24.9	75.5	56.2	21.0	156.1	195.2

NICKEL: SECONDARY PRODUCTION (8-2)

YEAR	NSCR
1947	8.655
1948	8.029
1949	5.153
1950	7.979
1951	7.804
1952	6.785
1953	7.578
1954	7.806
1955	10.470
1956	13.481
1957	10.920
1958	6.723
1959	8.562
1960	8.556
1961	9.691
1962	10.077
1963	17.233
1964	20.969
1965	17.606
1966	24.292
1967	18.807
1968	12.756
1969	17.032
1970	21.010
1971	24.345
1972	32.592
1973	29.601
1974	18.987
1975	16.220
1976	12.041
1977	11.294
1978	11.162
1979	11.976
1980	10.286

NICKEL: CONSUMPTION (8-3)

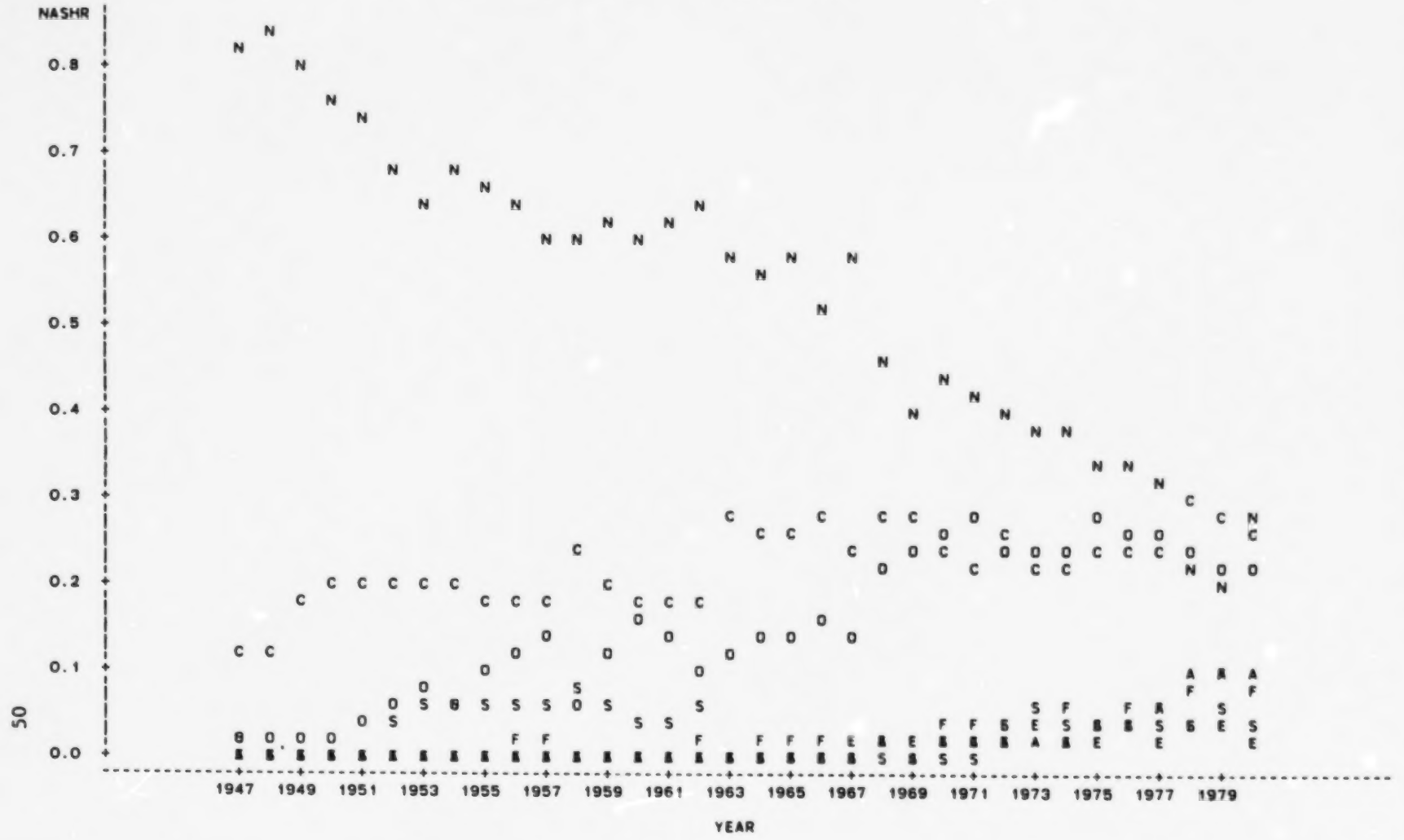
YEAR	NCNA	NCSA	NCAS	NCAF	NCEU	NCOC	NCCP
1947	74.8	0.3	0.5	0.0	28.7	0.8	17.0
1948	86.6	0.4	0.5	0.0	28.6	0.3	18.5
1949	63.8	0.2	0.8	0.0	28.0	1.2	25.5
1950	93.6	0.2	0.8	0.0	32.0	0.5	30.0
1951	81.9	0.3	1.0	0.0	36.9	0.3	34.0
1952	95.9	0.3	1.3	0.0	38.0	0.6	38.0
1953	100.0	0.3	2.0	0.0	38.4	0.6	41.0
1954	89.7	0.5	2.5	0.0	45.0	0.5	43.0
1955	104.9	0.5	3.5	0.1	52.2	0.6	45.1
1956	120.9	0.9	5.9	0.2	53.8	0.7	48.5
1957	115.5	0.8	6.7	0.3	59.5	0.9	51.6
1958	75.6	0.5	7.1	0.2	55.3	0.7	56.0
1959	105.9	0.5	11.0	0.3	69.8	1.3	59.0
1960	103.2	0.7	15.4	0.3	94.7	2.2	74.0
1961	114.7	1.2	21.3	0.5	88.9	1.2	80.0
1962	115.7	1.2	16.7	0.5	80.0	1.2	85.0
1963	118.2	1.5	24.5	0.5	87.7	2.0	108.4
1964	139.6	1.5	31.8	1.0	112.9	2.6	108.4
1965	164.2	1.5	27.7	2.0	120.2	2.5	110.5
1966	178.2	1.4	37.6	3.0	129.0	2.9	115.5
1967	165.7	1.5	51.7	4.0	131.1	3.5	115.5
1968	154.7	2.0	61.0	4.0	144.9	3.0	120.8
1969	149.8	1.8	76.4	4.0	147.0	2.9	120.9
1970	164.1	3.1	101.5	3.6	174.2	4.1	126.0
1971	144.5	2.9	94.2	3.5	146.8	3.9	130.8
1972	169.4	3.7	90.7	3.2	163.2	3.6	126.3
1973	192.9	7.6	117.3	5.0	184.5	5.0	127.2
1974	206.1	9.0	121.4	6.0	207.7	4.8	137.7
1975	144.2	8.7	88.2	6.0	159.2	2.3	150.6
1976	157.8	11.5	121.9	5.0	186.3	4.0	161.8
1977	149.8	10.0	107.0	5.2	182.8	4.3	165.6
1978	175.9	11.2	109.0	5.2	205.4	5.3	169.0
1979	190.1	12.2	143.3	5.4	229.5	4.8	172.6
1980	160.2	16.7	139.9	6.6	206.7	5.3	171.8

NICKEL: WORLD PRODUCTION, CONSUMPTION, AND PRICES (8-4)

YEAR	NPWRLD	NSCR	NCWRLD	PN	PS
1947	130.4	8.655	122.1	45.752	56.536
1948	142.5	8.029	134.9	44.123	58.128
1949	146.0	5.153	119.5	50.826	66.112
1950	148.2	7.979	157.1	54.758	65.098
1951	168.1	7.804	154.4	59.276	61.471
1952	186.7	6.785	174.1	63.770	64.673
1953	203.9	7.578	182.3	68.522	69.348
1954	218.8	7.806	181.2	69.010	71.895
1955	248.2	10.470	206.9	74.601	75.399
1956	265.1	13.481	230.9	71.847	77.960
1957	299.4	10.920	235.3	79.314	81.190
1958	226.6	6.723	195.4	78.224	83.002
1959	288.6	8.562	247.8	78.059	84.388
1960	339.4	8.556	290.5	77.977	84.299
1961	360.3	9.691	307.8	82.172	84.656
1962	351.5	10.077	300.3	84.277	84.388
1963	363.1	17.233	342.8	83.598	85.735
1964	392.0	20.969	397.8	83.421	88.701
1965	431.6	17.606	428.6	81.442	86.957
1966	415.6	24.292	467.6	79.058	85.391
1967	576.0	18.807	473.0	87.774	87.610
1968	545.1	12.756	490.4	92.683	86.829
1969	514.1	17.032	502.8	98.983	91.230
1970	663.2	21.010	576.6	116.834	94.185
1971	678.8	24.345	526.6	116.769	100.966
1972	623.3	32.592	560.1	117.269	104.954
1973	674.1	29.601	639.5	113.586	93.541
1974	743.2	18.987	692.7	108.057	104.110
1975	749.1	16.220	559.2	118.544	111.492
1976	764.7	12.041	648.3	123.087	114.470
1977	779.6	11.294	624.7	123.680	126.751
1978	632.4	11.162	681.0	99.904	135.155
1979	667.9	11.976	757.9	115.238	128.183
1980	736.6	10.286	707.2	127.093	129.773

PERCENTAGE DISTRIBUTION OF WORLD NICKEL PRODUCTION

PLOT OF NASHR*YEAR SYMBOL USED IS N
PLOT OF SASHR*YEAR SYMBOL USED IS S
PLOT OF ASSHR*YEAR SYMBOL USED IS A
PLOT OF AFSHR*YEAR SYMBOL USED IS F
PLOT OF EUSHR*YEAR SYMBOL USED IS E
PLOT OF OCSHR*YEAR SYMBOL USED IS O
PLOT OF CPSHR*YEAR SYMBOL USED IS C



Estimation

In order to obtain the most satisfactory parameter estimates for the equations making up the nickel market model, we employed dummy variables and permitted a change in structure in our estimations. These techniques are described as follows:

(1) The Dummy Variables

The basic purpose of our model is to identify and forecast the effects of exogenous variables on the endogenous variables, i.e. consumption, production, and price. When there is an outlier in the data, it will distort the basic underlying relation between the dependent and independent variables. To eliminate such adverse effects, we included zero-one dummy variables, which are obtained from the inspection of the data set. Some examples include: There is a sudden change in production in North America from 1977 to 1978. The same effect was apparant in South America and Oceania. This change is represented by dummy variables D_2. The production level of North America in 1967 (338.9) is exceptionally high, higher than in any other year (possible clerical error). This outlier is represented by dummy variable D_3. The reclassification of the centrally planned country group in 1963 is represented by D_4. All of the dummy variables used are summarized in the following table.

Dummy Variable	Dummy = 1 in	Used in		
		Production	Consumption	Scrap
D_2	1978-1979	NA, SA, OC		
D_3	1967	NA		
D_4	1963-1979	SA, CP	CP	
D_5	1972-1979	SA		
D_6	1970-1979	AS		
D_7	1977-1979	AS, EU		
D_8	1969-1979	AF, EU		
D_9	1968-1979	OC		
D_{10}	1958	NA		
D_{11}	1975-1979		NA, EU, OC	
D_{12}	1958-1979			NA
D_{13}	1974-1979			NA
D_{14}	1967-1979		AS	
D_{15}	1973-1979		SA	
D_{16}	1970		NA, SA, AS, EU	

(2) Changes in Market Structure

The most notable departure of the current model from the previous one is that this model attempts to capture the change in the market structure. In the early years of our data series, North America was the dominant producer in the world. In 1950, for example, North American production represented more than 75% of the world production and almost 95% of the free world production. These figures are reduced to 40% and 53%, respectively, in 1972, and further reduced in 1979 to 20% and 29%, respectively.

This change in the market is expected to have some effect on the production decision of the dominant producer, i.e., North America. Economic theory suggests that the production decision of the dominant firm depends on the difference between the total demand and the total supplied by other firms (or in our case country groups); that is, (NC - ROWS). Hence, we expect that the effect of this variable on the production decision of North America would have changed over time. Let $Z_t = NC_t - ROWS_t$. Assuming that the effect of this variable has a one-year lag we may write

$$(1) \qquad Q_t = \alpha Z_{t-1}$$

Since we expect a smaller effect of Z on output as the firm loses its dominant position, the value of α is expected to be smaller in later years for North-American production. This may be formulated as

$$(2) \qquad Q_t = \begin{cases} a_o Z_t - 1 & \text{if } t < t_o \\ a_1 Z_t - 1 & \text{if } t \geq t_o \end{cases}$$

where t_o is a critical year in which the shift [change in structure] has occurred.

The above formulation implies that there is a sudden shift in the effect of Z. However, the loss of the market share of the North America has been gradual rather than sudden. Equation (2) does not capture such a gradual decline in market share. Hence, it would be more appropriate to specify the coefficient of Z_{t-1} as a function of time:

$$(3) \qquad Q_t = \alpha Z_{t-1} = (b_o + b_1 t) Z_{t-1},$$

where the value of α declines over time if b_1 is negative and b_o is positive.

There is still one drawback in formulation (3). Once the firm loses its dominant position and becomes one of the many competitors the effect of Z is expected to stay the same over time. Equation (3), however, implies a continuous decline of the value of α over time regardless of the position of the firm in the market.

To remedy this drawback, suppose that the firm starts behaving as a competitor from year t_o. Then, we may specify

$$(4) \qquad Q_t = \begin{cases} (b_o + b_1 t) Z_{t-1} & \text{if } t < t_o \\ (b_o + b_1 t_o) Z_{t-1} & \text{if } t \geq t_o \end{cases}$$

The effect of Z then declines over time until year $t_o - 1$ and it stays at the level $(b_o + b_1 t_o)$ from year t_o.

To implement (4) we need to find the critical year t_o. From the graph presented earlier, the North-American country group appears to have lost its dominant position in the world sometime around 1965 or 1966. However, our data indicates that it was not until sometime in the 1970's that behavior in production in North America was altered.

We have tried different years in the 1970's and found the best estimation for t_o = 1973. For this critical year the estimates are b_o = 3.26 and b_1 = -0.04. The marginal effect of Z_{t-1} declines from 1.26 in 1950 to 0.38 in 1972, and then stays at the level 0.34.

Finalization

We next performed the in-sample predictions for the nickel market for the period 1965-1979. Following are the actual and predicted values obtained. (Again note that prices are expressed in 1979 U.S. dollars.) For the world levels, we plotted actual and predicted values with the symbol * indicating the actual value and P indicating our in-sample prediction. These plots are followed by the descriptive statistics used to evaluate econometric predictions.

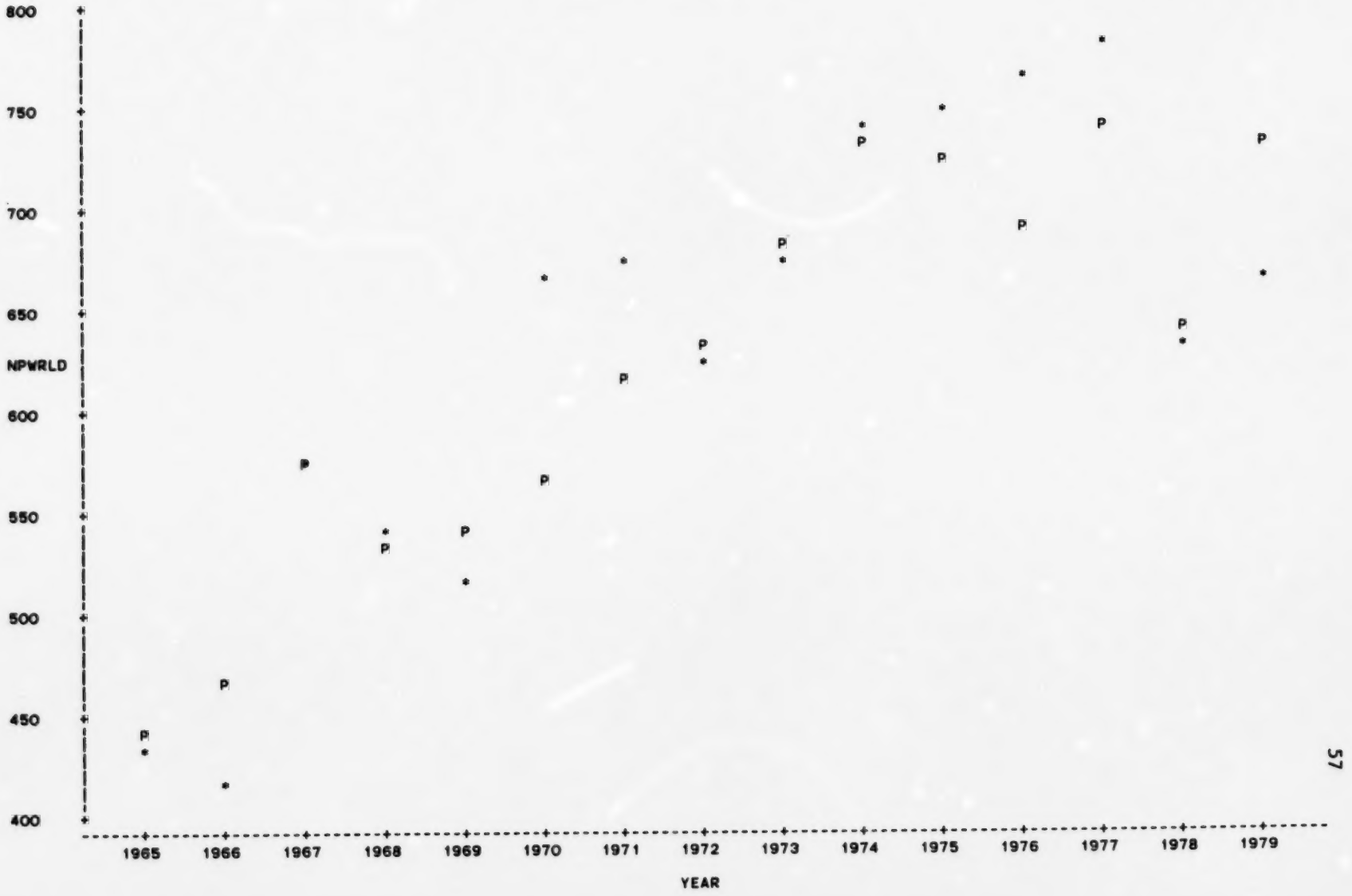
COMPARISON OF ACTUAL AND PREDICTED VALUES -- NICKEL

YEAR	NCNA	CNA	NCSA	CSA	NCAS	CAS	NCAF	CAF	NCEU	CEU	NCOC	COC	NCCP	CCP	NPNA	PNA	NPSA	PSA	NPAS
1965	164.2	147.677	1.5	1.4769	27.7	33.993	2.0	1.76871	120.2	118.211	2.5	2.42940	110.5	111.449	247.4	243.906	1.1	0.6909	2.4
1966	178.2	155.036	1.4	1.6136	37.6	38.667	3.0	2.32443	129.0	119.098	2.9	2.65723	115.5	113.973	214.9	245.485	1.1	0.5542	2.6
1967	165.7	156.542	1.5	1.6225	51.7	59.070	4.0	2.71556	131.1	126.048	3.5	2.59979	115.5	116.289	338.9	343.634	1.1	0.7006	3.9
1968	154.7	160.526	2.0	1.9349	61.0	69.597	4.0	2.82430	144.9	133.435	3.0	3.23031	120.8	121.221	253.5	252.168	1.1	-0.0949	5.7
1969	149.8	169.752	1.8	2.4672	76.4	70.645	4.0	2.98202	147.0	150.970	2.9	3.60934	120.9	124.714	208.1	231.148	1.3	1.0388	5.0
1970	164.1	170.430	3.1	3.2410	101.5	101.500	3.6	3.26185	174.2	175.704	4.1	3.86903	126.0	127.512	291.6	234.018	3.0	2.2612	10.9
1971	144.5	168.921	2.9	3.1602	94.2	83.738	3.5	3.62797	146.8	167.493	3.9	4.03700	130.8	130.385	281.2	252.505	3.5	3.9577	15.0
1972	169.4	185.698	3.7	3.4534	90.7	97.929	3.2	3.97217	163.2	177.972	3.6	4.28310	126.3	135.408	249.2	243.975	20.8	24.0721	14.5
1973	192.9	201.834	7.6	8.1080	117.3	106.603	5.0	4.37837	184.5	193.650	5.0	4.98686	127.2	139.088	261.6	254.769	34.2	29.8871	16.3
1974	206.1	191.297	9.0	9.0559	121.4	102.126	6.0	4.49327	207.7	190.421	4.8	4.81407	137.7	141.413	281.9	267.423	34.0	31.8435	16.4
1975	144.2	140.565	8.7	9.2712	88.2	92.710	6.0	5.05887	159.2	163.505	2.3	3.08029	150.6	147.796	255.2	252.185	30.1	31.3607	24.2
1976	157.8	141.826	11.5	10.0020	121.9	127.000	5.0	4.80778	186.3	182.404	4.0	4.05924	161.8	156.101	252.7	222.618	29.8	29.1634	29.1
1977	149.8	163.170	10.0	10.6279	107.0	117.027	5.2	4.96580	182.8	194.922	4.3	4.09633	165.6	162.181	245.1	239.034	29.0	30.9011	52.9
1978	175.9	180.428	11.2	11.2601	109.0	122.029	5.2	5.18537	205.4	206.812	5.3	4.68783	169.0	169.736	140.1	150.643	19.7	29.9047	59.8
1979	190.1	196.676	12.2	12.1058	143.3	133.624	5.4	5.37568	229.5	227.374	4.8	5.10335	172.6	174.048	138.6	186.134	34.3	32.5177	69.2

YEAR	PAS	NPAF	PAF	NPEU	PEU	NPOC	POC	NPCP	PCP	NCWRLD	CWRLD	NPWRLD	PWRLD	NSCR	SCR	PN	PNH
1965	3.6384	6.3	5.3960	3.0	4.2559	61.2	69.441	110.2	117.499	428.6	417.004	431.6	444.828	17.606	18.2747	191.877	208.634
1966	6.8714	6.5	6.0460	3.0	5.2895	67.8	74.770	119.7	124.626	467.6	433.370	415.6	463.642	24.292	19.0303	186.261	216.797
1967	10.5206	6.9	7.6860	5.9	6.6037	84.8	79.554	134.5	129.998	473.0	464.886	576.0	578.696	18.807	20.0976	206.796	224.009
1968	11.4575	9.0	9.1353	7.4	7.4925	120.8	118.196	147.6	134.414	490.4	492.768	545.1	532.768	12.756	21.2624	218.361	217.474
1969	12.7701	15.0	15.1174	9.2	9.7361	128.0	131.629	147.5	139.632	502.8	525.139	514.1	541.071	17.032	21.8296	233.204	221.460
1970	8.4630	20.3	22.7059	13.6	12.1212	168.3	146.168	155.5	145.043	576.6	585.518	663.2	570.781	21.010	22.5086	275.261	230.739
1971	8.5259	22.3	24.7996	14.6	13.2782	186.4	159.227	155.8	151.123	526.6	561.362	678.8	613.416	24.345	23.2771	275.108	245.817
1972	8.3361	22.0	31.2303	17.0	15.8031	143.6	150.819	156.2	155.241	560.1	608.715	623.3	629.476	32.592	25.9910	276.285	251.076
1973	10.2523	31.1	37.6914	20.3	18.8485	156.0	170.681	154.6	160.631	639.5	658.647	674.1	682.760	29.601	28.7670	267.608	260.517
1974	13.5436	42.8	39.9129	21.8	20.4824	182.9	195.102	163.4	166.338	692.7	643.620	743.2	734.645	18.987	18.3595	254.583	268.446
1975	14.8476	36.5	37.7508	20.9	19.6086	209.3	196.154	172.9	170.721	559.2	561.987	749.1	722.627	16.220	11.8020	279.289	267.940
1976	10.9216	49.7	44.6241	23.2	21.7195	202.2	187.111	178.0	173.343	648.3	626.199	764.7	689.501	12.041	9.1318	289.994	256.896
1977	30.2172	50.6	49.2893	15.9	13.7989	202.7	196.691	183.4	179.233	624.7	656.989	779.6	739.164	11.294	9.5888	291.389	261.462
1978	46.6156	54.4	54.6276	19.8	19.0053	149.6	153.546	189.0	185.044	681.0	700.138	632.4	639.386	11.162	11.8149	235.375	265.449
1979	66.6102	61.0	60.5679	21.0	22.4010	152.6	171.461	191.2	192.309	757.9	754.306	667.9	732.001	11.976	14.1615	271.500	293.328

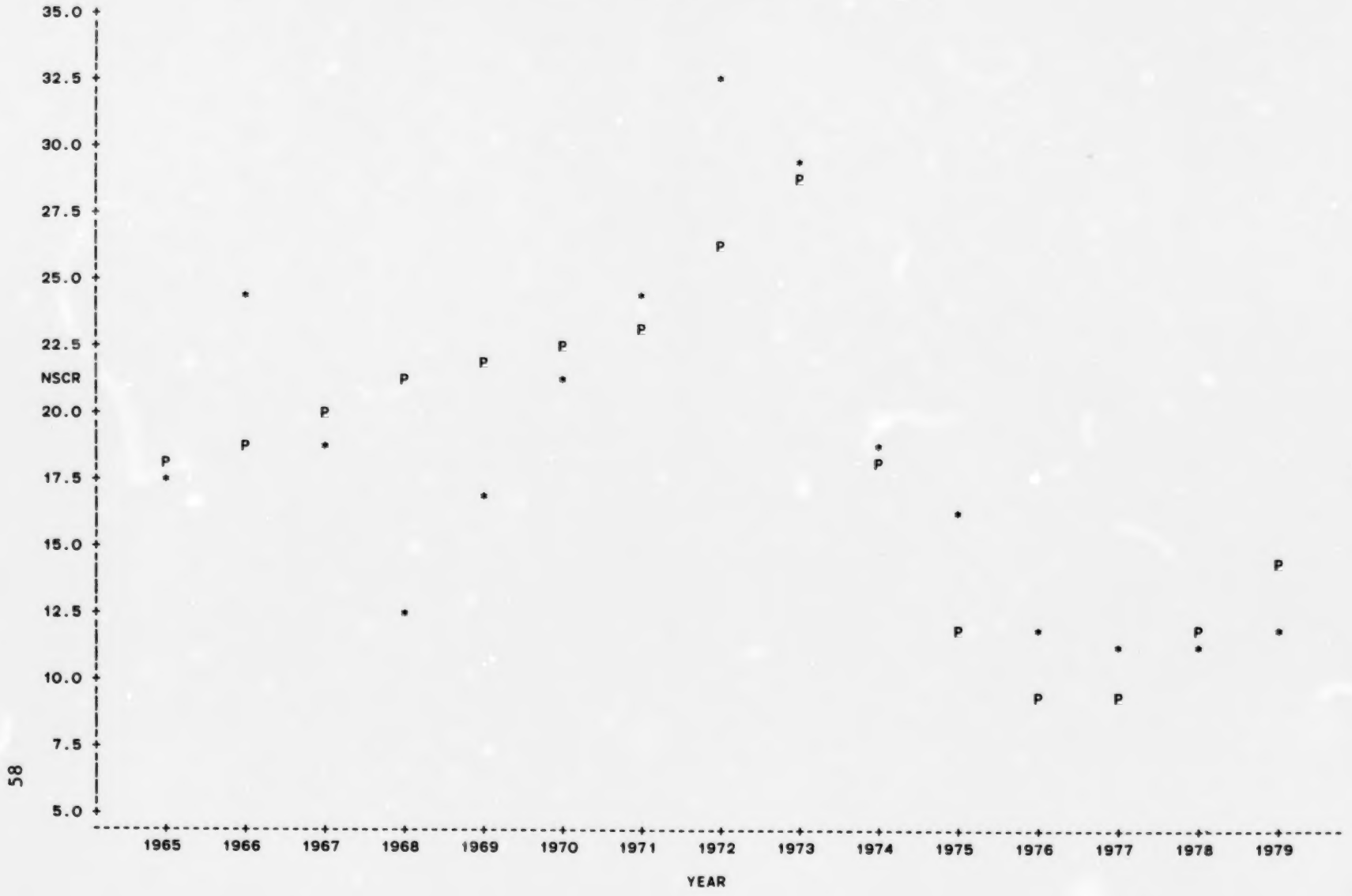
WORLD NICKEL PRIMARY PRODUCTION

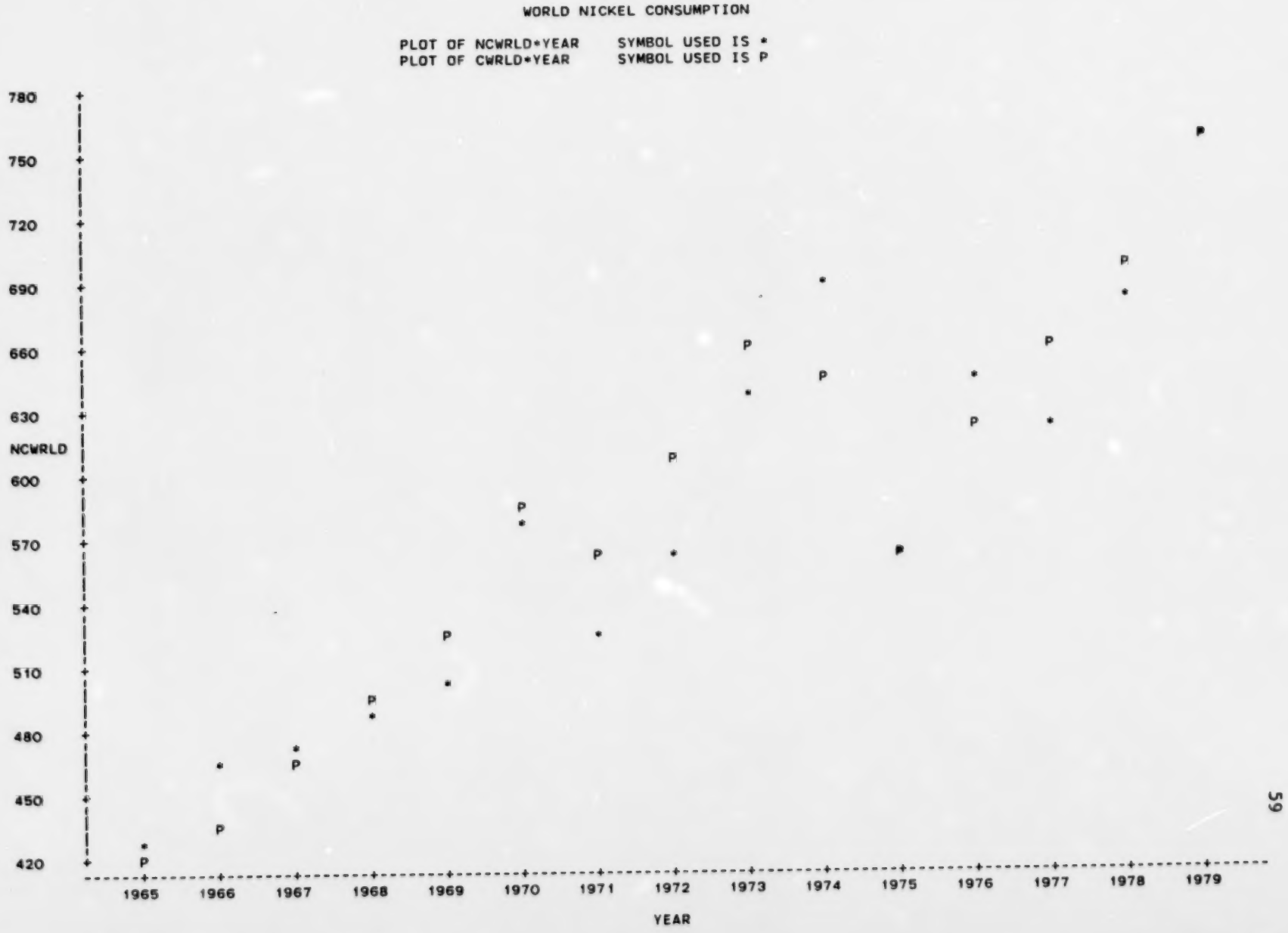
PLOT OF NPWRLD*YEAR SYMBOL USED IS *
PLOT OF PWRLD*YEAR SYMBOL USED IS P



NICKEL SECONDARY PRODUCTION

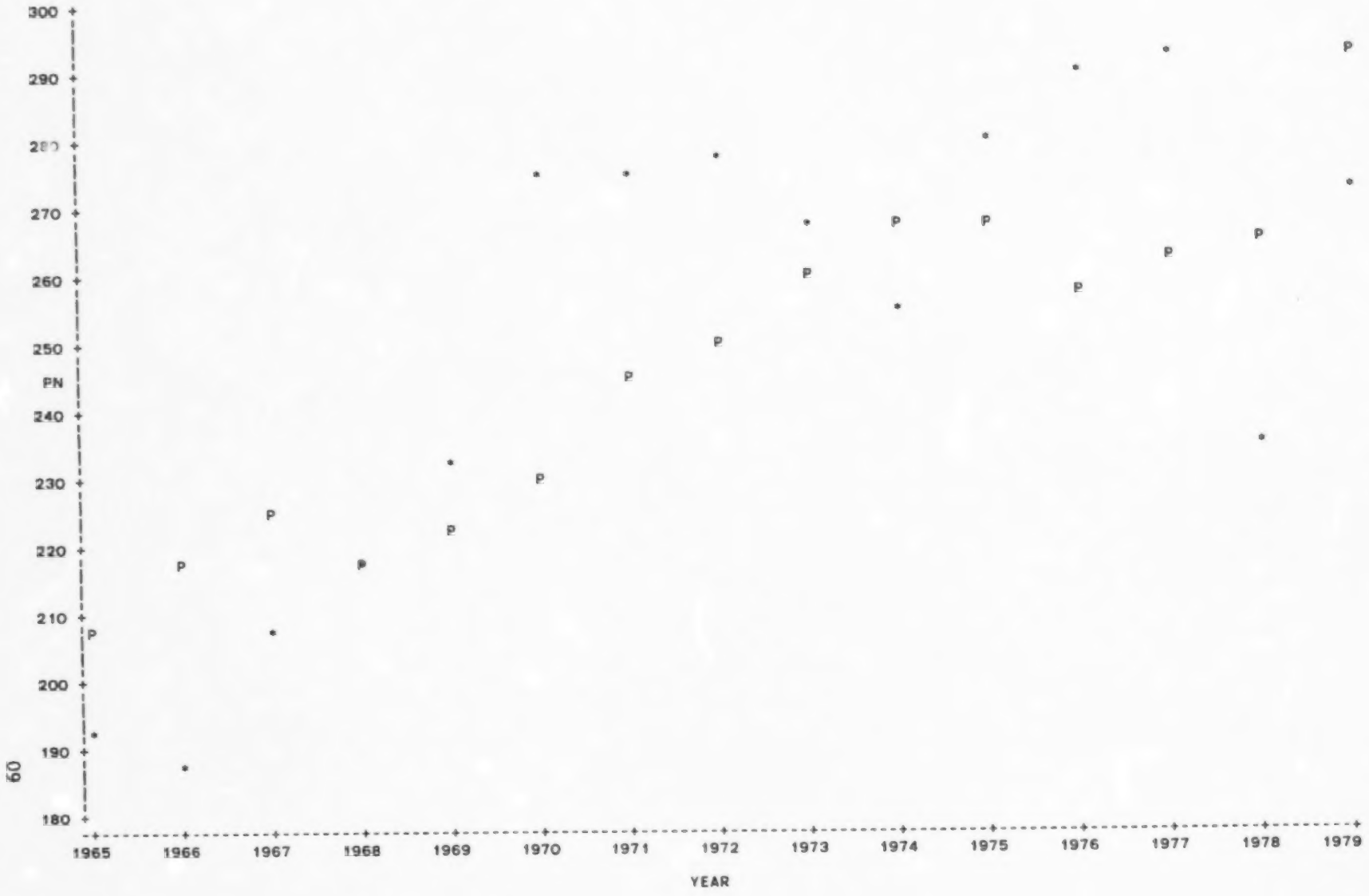
PLOT OF NSCR*YEAR SYMBOL USED IS *
PLOT OF SCR*YEAR SYMBOL USED IS P




WORLD NICKEL CONSUMPTION
PLOT OF NCWRLD*YEAR SYMBOL USED IS *
PLOT OF CWRLD*YEAR SYMBOL USED IS P
780
750
720
690
660
630
NCWRLD
600
570
540
510
480
450
420
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR

WORLD NICKEL PRICE

PLOT OF PN*YEAR SYMBOL USED IS *
PLOT OF PNH*YEAR SYMBOL USED IS P



EVALUATION OF IN-SAMPLE PREDICTIONS -- NICKEL

FUNCTION	ME	MPE	RMSE	RMSPE
CNA	1.5318	0.01243	14.2301	0.088150
CSA	0.0867	0.04629	0.5097	0.119163
CAS	0.4906	0.02807	9.1651	0.110295
CAF	-0.4905	-0.10997	0.7720	0.181365
CEU	1.0813	0.00617	9.9762	0.062106
COC	0.0429	0.02503	0.4539	0.144915
CCP	1.3677	0.01179	4.5737	0.034854
PNA	-2.6902	0.00749	24.8289	0.122288
PSA	0.3106	-0.14093	3.1597	0.377412
PAS	-4.2873	0.20648	9.6633	0.842251
PAF	0.8120	0.04143	3.4639	0.142170
PEU	-0.4104	0.04927	1.3586	0.236730
POC	-1.0432	0.00661	13.2076	0.087385
PCP	-2.2869	-0.01279	6.1720	0.042556
SCR	-0.2549	0.01188	3.7356	0.233682
CWRLD	4.1101	0.00701	26.1042	0.045534
PWRLD	-9.5959	-0.00815	43.6051	0.068129
PRICE	-4.1898	-0.00671	24.3136	0.097122

Simulation Equations

On the basis of our in-sample predictions, we selected the best simulation model for nickel. The equations used in the final simulation model are displayed in the following tables.

SIMULATION EQUATIONS - PRIMARY PRODUCTION - NICKEL

VARIABLE	NA	SA	AS	AF	EU	OC	CP
CONSTANT	-304.3195	11.8597	23.6930	2.5149	17.9147	-90.8726	-2.2851
PN	1.3588	0.2218	0.5691	.	0.0936	0.7364	0.1149
PNLAG	1.7498	-0.2073	-0.0228	.	0.1346	-0.0694	-0.1144
PNLAG2	.	.	.	.	.	.	.
ROWSLAG	-0.3039	.	.	.	.	.	.
D	0.0490	.	.	0.0633	0.0285	.	.
DLAG	0.3039	0.0133	0.0169	-0.0596	0.0132	0.1316	0.0181
DLAG2	.	.	.	.	.	.	.
T	0.3553	.	-0.9578	.	-0.9245	.	0.9647
R	.	.	.	.	-0.0128	9.9891	.
RLAG	-1.0540	.	.	.	.	-2.5012	.
PASTPROD	.	.	.	.	0.1270	.	0.0116
LAGPROD	0.0259	0.2365	0.8249	0.9515	-0.1660	0.0867	0.3922

SIMULATION EQUATIONS - SECONDARY PRODUCTION - NICKEL

VARIABLE	NA
CONSTANT	-28.0829
PN	.
PNLAG	0.1934
PNLAG2	.
D	0.0771
DLAG	0.0189
DLAG2	-0.0089
DLAG3	.
LAGSCR	0.2840

SIMULATION EQUATIONS - CONSUMPTION - NICKEL

VARIABLE	NA	SA	AS	AF	EU	OC	CP
CONSTANT	-69.6494	-1.1617	-28.8231	-0.5931	-140.9059	-9.1576	24.9228
PNPS	.	.	.	.	.	.	.
PNPSLAG	-0.2269	-0.0082	.	-0.0005	-0.4656	-0.0174	-0.1561
PNPSLAG2	.	.	.	.	.	.	.
INVENLAG	-0.0508	.	.	.	-0.0417	-0.0010	0.0257
Y	258.0669	12.1220	348.9661	-8.0050	275.1772	10.8335	.
YLAG	-110.7406	-4.5667	-267.7677	9.6087	35.1165	1.7381	30.8044
KGLAG	4.6483	.	108.6565	.	2.3383	.	.
MGLAG	2.4535	.	.	.	-0.3166	0.0169	.
LAGCON	0.2723	0.1498	.	0.8520	-0.1571	-0.2691	0.5931

SIMULATION EQUATIONS - PRICE - NICKEL

VARIABLE	WORLD
CONSTANT	2.0132
PNLAG	1.1084
PNLAG2	-0.0947
INVENLAG	-0.0699
SUPPLY	.
T	.
Y	.
R	.
PS	.
PSLAG	0.0372
PSLAG2	.

-ZINC-

Data

The updated data for zinc are displayed in the following tables. These data reflect revisions contained in the most recent issue of Metal Statistics. As with the data for the other minerals, prices are expressed in 1967 U.S. dollars.

ZINC: PRIMARY PRODUCTION (9-1)

YEAR	ZPNA	ZPSA	ZPAS	ZPAF	ZPEU	ZPOC	ZPCP
1947	767.0	325.0	28.8	81.5	193.4	179.1	193.6
1948	783.9	310.4	35.9	93.3	231.4	180.3	233.3
1949	799.6	279.1	45.0	109.7	268.5	182.7	257.0
1950	849.7	344.2	52.9	150.3	314.1	201.0	274.8
1951	927.5	334.0	78.6	176.4	350.3	192.3	304.4
1952	941.5	415.0	98.9	196.6	378.7	199.6	377.8
1953	861.1	415.2	111.9	239.7	388.5	243.2	464.9
1954	771.0	427.6	126.4	204.4	424.6	256.7	490.3
1955	860.0	492.6	128.9	205.8	446.9	260.7	501.9
1956	875.4	487.0	143.9	269.1	476.8	282.5	531.8
1957	857.7	469.5	157.6	277.0.	492.9	296.3	554.8
1958	759.4	419.1	168.9	275.8	505.3	298.5	589.0
1959	745.1	462.1	167.8	239.6	506.7	280.0	623.2
1960	764.1	507.9	187.7	272.1	495.8	322.5	667.4
1961	798.7	500.4	193.7	257.8	515.2	316.2	668.4
1962	878.4	465.2	219.3	247.3	501.7	343.1	689.1
1963	909.9	480.9	232.3	246.3	510.0	357.1	701.9
1964	1142.5	514.2	253.5	273.7	499.5	350.1	759.9
1965	1300.1	535.3	262.2	297.7	466.5	354.8	831.6
1966	1394.0	559.8	303.8	259.2	495.6	375.3	898.0
1967	1506.7	605.5	322.9	244.6	526.8	407.0	977.9
1968	1532.1	590.0	340.4	256.3	587.8	422.4	1037.6
1969	1696.0	635.7	351.8	250.8	685.0	551.5	1054.9
1970	1737.7	682.7	371.6	249.1	673.7	488.7	1127.7
1971	1726.2	717.4	400.1	254.8	653.0	454.6	1185.0
1972	1705.5	791.7	405.2	245.1	666.9	508.8	1244.9
1973	1792.0	856.8	394.4	238.5	642.1	481.1	1348.1
1974	1693.7	893.4	421.8	255.8	634.2	457.1	1394.7
1975	1655.3	839.0	447.4	275.7	609.6	500.8	1465.5
1976	1584.5	981.3	466.7	245.2	675.3	468.6	1486.6
1977	1708.1	1014.8	509.2	250.7	748.6	491.6	1515.8
1978	1582.3	973.4	477.2	270.0	856.2	473.3	1505.4
1979	1498.2	1001.7	412.3	230.1	872.2	529.2	1500.9
1980	1426.7	1034.8	382.5	240.4	930.6	493.7	1448.8

ZINC: SECONDARY PRODUCTION (9-2)

YEAR	ZSCR
1947	.
1948	667.7
1949	601.7
1950	699.4
1951	711.2
1952	675.9
1953	663.9
1954	673.8
1955	731.1
1956	697.4
1957	645.7
1958	606.3
1959	685.8
1960	722.3
1961	670.1
1962	678.6
1963	691.8
1964	762.5
1965	826.1
1966	855.8
1967	813.9
1968	935.7
1969	991.4
1970	1006.4
1971	1026.0
1972	1089.1
1973	1148.2
1974	1067.3
1975	937.3
1976	1107.7
1977	1152.6
1978	1153.6
1979	1247.4
1980	1226.6

ZINC: CONSUMPTION (9-3)

YEAR	ZCNA	ZCSA	ZCAS	ZCAF	ZCEU	ZCOC	ZCCP
1947	791.3	22.3	70.3	10.6	550.3	39.4	185.8
1948	817.5	24.9	72.2	12.5	563.2	43.5	221.9
1949	716.4	32.8	77.8	11.9	602.4	45.5	234.5
1950	964.3	31.4	77.4	15.1	679.6	51.9	253.1
1951	898.6	44.5	91.8	15.2	676.1	48.6	298.3
1952	816.6	38.3	93.6	12.6	628.3	50.5	325.8
1953	937.1	37.9	109.4	13.1	680.1	57.1	358.3
1954	841.4	50.4	132.8	17.0	863.3	62.1	388.0
1955	1065.9	50.5	147.2	19.9	916.3	71.7	405.9
1956	966.0	57.6	155.7	24.3	883.7	70.5	443.2
1957	890.1	49.7	186.3	25.3	924.8	80.3	446.3
1958	831.3	67.0	208.9	23.7	941.2	74.5	517.6
1959	922.6	65.8	217.2	21.7	999.6	80.1	544.4
1960	838.9	78.0	271.3	30.2	1100.6	93.9	592.3
1961	895.4	79.3	339.2	25.4	1133.1	78.9	601.7
1962	977.4	81.8	342.5	29.3	1119.4	82.1	625.0
1963	1068.7	92.3	428.8	40.6	1148.7	92.5	665.9
1964	1182.4	105.3	479.7	48.1	1245.0	108.4	676.7
1965	1316.2	106.8	452.0	42.9	1240.1	99.0	725.9
1966	1382.5	119.8	513.4	50.7	1226.5	94.4	751.8
1967	1230.3	123.6	602.4	62.1	1214.6	108.2	850.9
1968	1335.2	136.3	696.5	54.2	1342.1	105.4	914.3
1969	1367.9	155.3	779.8	64.5	1505.4	120.0	978.4
1970	1181.0	164.3	825.9	76.6	1463.8	122.0	1043.1
1971	1251.3	176.6	836.3	77.6	1450.2	115.5	1106.6
1972	1421.9	200.6	959.0	72.1	1600.8	127.5	1158.7
1973	1516.7	218.7	1048.9	89.0	1749.4	135.0	1263.1
1974	1308.9	240.2	955.4	103.7	1696.3	132.4	1346.8
1975	988.8	226.4	776.6	102.2	1259.5	89.7	1379.3
1976	1173.8	244.4	984.5	101.2	1476.5	101.2	1433.2
1977	1132.4	254.2	1055.2	91.5	1500.3	96.2	1448.5
1978	1196.1	306.0	1154.0	115.2	1612.3	107.6	1525.3
1979	1154.1	330.5	1209.8	118.9	1626.2	117.6	1529.1
1980	942.9	329.5	1152.3	132.8	1627.9	120.0	1562.7

ZINC: WORLD PRODUCTION, CONSUMPTION, AND PRICES (9-4)

YEAR	ZPWRLD	ZSCR	ZCWRLD	PZ	PS
1947	1768.4	.	1670.0	13.7255	56.536
1948	1868.5	667.7	1755.7	16.4118	58.128
1949	1941.6	601.7	1721.3	15.4307	66.112
1950	2187.0	699.4	2072.8	16.9511	65.098
1951	2363.5	711.2	2073.1	19.7585	61.471
1952	2608.1	675.9	1965.7	18.1998	64.673
1953	2724.5	663.9	2193.0	12.4199	69.348
1954	2701.0	673.8	2355.0	12.1929	7:.895
1955	2896.8	731.1	2677.4	14.0080	75.399
1956	3066.5	697.4	2601.0	14.8776	77.960
1957	3105.8	645.7	2602.8	12.2176	81.190
1958	3016.0	606.3	2664.2	10.8975	83.002
1959	3024.5	685.8	2851.4	12.0759	84.388
1960	3217.5	722.3	3005.2	13.6417	84.299
1961	3250.4	670.1	3153.0	12.2138	84.656
1962	3344.1	678.6	3257.5	12.2627	84.388
1963	3438.4	691.8	3537.5	12.6952	85.735
1964	3793.4	762.5	3845.6	14.3273	88.701
1965	4048.2	826.1	3982.9	15.0104	86.957
1966	4285.7	855.8	4139.1	14.5291	85.391
1967	4591.4	813.9	4192.1	13.8430	87.610
1968	4766.6	935.7	4584.0	13.1707	86.829
1969	5225.7	991.4	4971.3	13.7089	91.230
1970	5331.2	1006.4	4876.7	13.8759	94.185
1971	5391.1	1026.0	5014.1	14.1598	100.966
1972	5568.1	1089.1	5540.6	14.9093	104.954
1973	5753.0	1148.2	6020.8	15.3363	93.541
1974	5750.7	1067.3	5783.7	22.4516	104.110
1975	5793.3	937.3	4822.5	22.2750	111.492
1976	5908.2	1107.7	5514.8	20.2240	114.470
1977	6238.8	1152.6	5578.3	17.7096	126.751
1978	6137.8	1153.6	6016.5	14.7974	135.155
1979	6044.6	1247.4	6086.2	15.8302	128.183
1980	5957.5	1226.6	5878.1	13.9293	129.773

Estimation

In the case of consumption, a dummy variable for the period 1975-79 was used to account for the lowered consumption in North America, South America, Europe, and Oceania. (In our simulation model we assume that this reduction will continue in the future.) For Asia, only 1975 was dummied.

For secondary production, a dummy variable was used for the reduction in 1975. Finally, in the price equation, a dummy variable was used for the period 1974-76.

Finalization

Using the system of 16 equations that make up the zinc model, we performed in-sample predictions for the period 1965-79. The actual and predicted values obtained are displayed in the following table. (In this note again that actual values are presented first and that the prices are expressed in 1979 U.S. dollars.) Next, we present the plots of actual and predicted values for the world values of consumption, production, and price. (Actual values are identified with the symbol * and predicted values are identified with the symbol P.) Finally, we provide the summary statistics -- i.e., mean error, mean percentage error, root mean squared error, and root mean squared percentage error -- for each of the equations.

COMPARISON OF ACTUAL AND PREDICTED VALUES -- ZINC

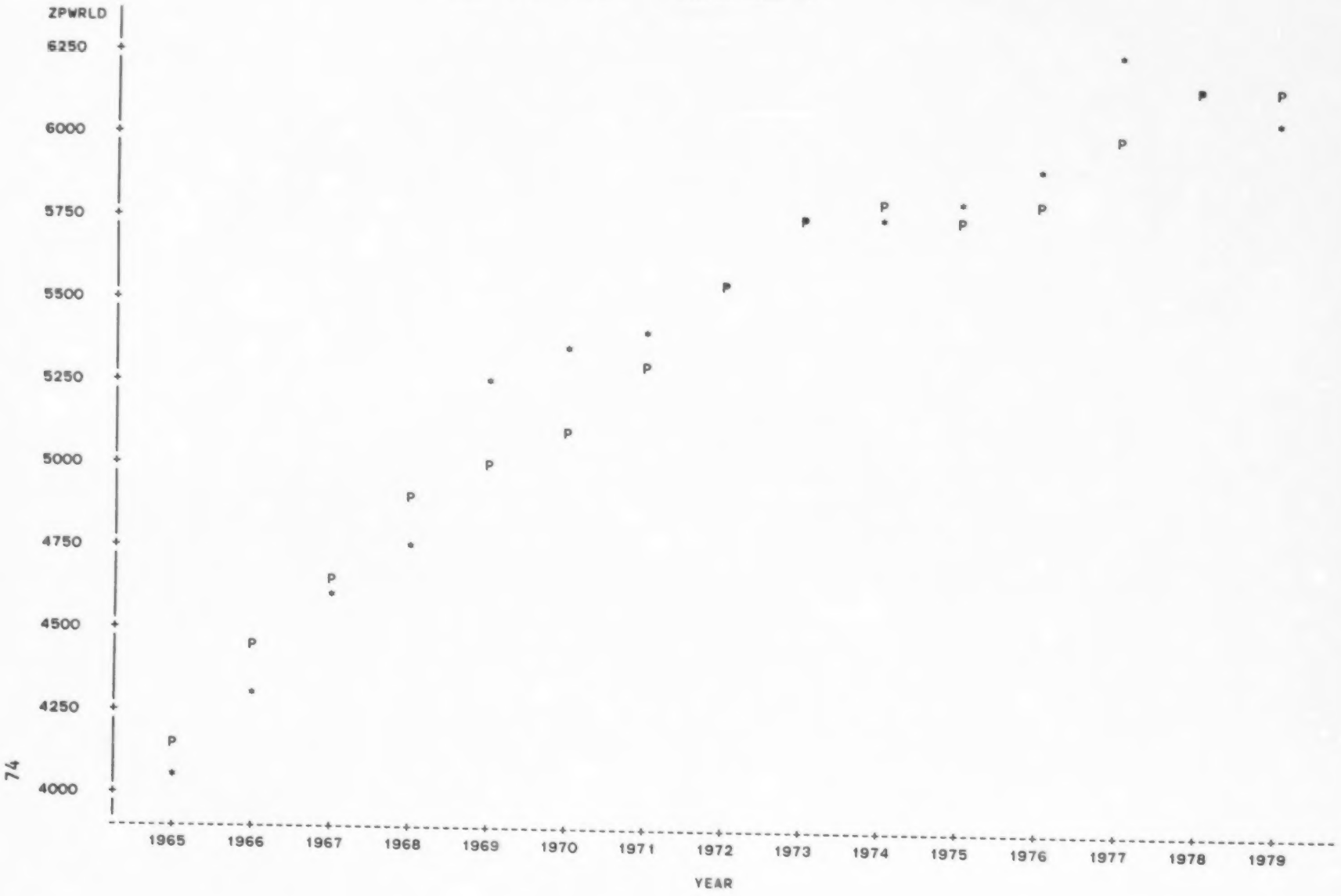
YEAR	ZCNA	CNA	ZCSA	CSA	ZCAS	CAS	ZCAF	CAF	ZCEU	CEU	ZCOC	COC
1965	1316.2	1228.97	106.8	111.909	452.0	521.22	42.9	52.380	1240.1	1249.99	99.0	101.168
1966	1382.5	1287.81	119.8	118.160	513.4	571.27	50.7	53 815	1226.5	1234.94	94.4	100.981
1967	1230.3	1223.09	123.6	122.803	602.4	596.12	62.1	55.032	1214.6	1279.13	108.2	101.329
1968	1335.2	1368.38	136.3	133.119	696.5	670.56	54.2	58.348	1342.1	1345.71	105.4	107.352
1969	1367.9	1298.29	155.3	150.633	779.8	682.42	64.5	64.299	1505.4	1444.16	120.0	114.988
1970	1181.0	1244.16	164.3	166.426	825.9	733.11	76.6	70.924	1463.8	1504.30	122.0	119.016
1971	1251.3	1301.44	176.6	182.487	836.3	812.06	77.6	76.759	1450.2	1520.87	115.5	123.663
1972	1421.9	1441.66	200.6	200.629	959.0	896.84	72.1	81.674	1600.8	1623.33	127.5	128.567
1973	1516.7	1514.82	218.7	220.846	1048.9	954.96	89.0	85.613	1749.4	1714.37	135.0	134.534
1974	1308.9	1323.99	240.2	237.256	955.4	995.01	103.7	90.194	1696.3	1645.85	132.4	134.620
1975	988.8	994.50	226.4	222.959	776.6	798.07	102.2	93.984	1259.5	1262.17	89.7	88.285
1976	1173.8	1135.53	244.4	243.006	984.5	931.67	101.2	99.589	1476.5	1450.44	101.2	96.214
1977	1132.4	1204.57	254.2	268.143	1055.2	1075.88	91.5	90.752	1500.3	1476.84	96.2	99.894
1978	1196.1	1194.99	306.0	297.163	1154.0	1169.81	115.2	110.771	1612.3	1577.58	107.6	108.125
1979	1154.1	1144.94	330.5	330.481	1209.8	1249.60	118.9	126.133	1626.2	1708.50	117.6	120.402

YEAR	ZCCP	CCP	ZPNA	PNA	ZPSA	PSA	ZPAS	PAS	ZPAF	PAF	ZPEU	PEU
1965	725.9	715.31	1300.1	1339.80	535.3	562.591	262.2	270.108	297.7	262.124	466.5	521.510
1966	751.8	771.76	1394.0	1464.95	559.8	603.861	303.8	285.973	259.2	256.723	495.6	542.368
1967	850.9	826.87	1506.7	1536.76	605.5	635.140	322.9	300.300	244.6	254.259	526.8	563.838
1968	914.3	900.43	1532.1	1609.04	590.0	672.775	340.4	312.360	256.3	252.362	587.8	603.371
1969	978.4	934.08	1696.0	1623.81	635.7	696.199	351.8	323.688	250.8	252.395	685.0	614.381
1970	1043.1	1006.03	1737.7	1632.89	682.7	720.707	371.6	334.927	249.1	252.155	673.7	621.938
1971	1106.6	1057.90	1726.2	1686.22	717.4	745.380	400.1	347.164	254.8	251.771	653.0	635.524
1972	1158.7	1099.52	1705.5	1769.47	791.7	782.966	405.2	360.255	245.1	252.254	666.9	666.136
1973	1263.1	1179.79	1792.0	1833.88	856.8	823.469	394.4	373.286	238.5	254.045	642.1	684.444
1974	1346.8	1250.04	1693.7	1809.85	893.4	844.413	421.8	400.713	255.8	256.048	634.2	656.999
1975	1379.3	1300.52	1655.3	1693.20	839.0	861.280	447.4	430.244	275.7	258.997	609.6	634.926
1976	1433.2	1380.07	1584.5	1634.69	981.3	905.215	466.7	455.310	245.2	253.526	675.3	700.715
1977	1448.5	1439.97	1708.1	1652.25	1014.8	943.390	509.2	468.410	250.7	253.261	748.6	762.408
1978	1525.3	1519.25	1582.3	1616.26	973.4	964.158	477.2	472.964	270.0	252.507	856.2	816.069
1979	1529.1	1559.40	1498.2	1564.88	1001.7	974.050	412.3	477.109	230.1	251.831	872.2	846.042

YEAR	ZPOC	POC	ZPCP	PCP	ZCWRLD	CWRLD	ZPWRLD	PWRLD	ZSCR	SCR	PZ	PZH
1965	354.8	379.319	831.6	833.17	3982.9	3980.95	4048.2	4168.62	826.1	810.28	35.3644	34.4196
1966	375.3	399.962	898.0	897.78	4139.1	4138.73	4285.7	4451.62	855.8	851.52	34.2305	34.7709
1967	407.0	415.593	977.9	952.55	4192.1	4204.38	4591.4	4658.44	813.9	871.49	32.6141	34.4391
1968	422.4	428.677	1037.6	1007.76	4584.0	4583.90	4766.6	4886.35	935.7	933.17	31.0302	32.3126
1969	551.5	438.286	1054.9	1059.06	4971.3	4688.88	5225.7	5007.82	991.4	947.39	32.2982	32.8986
1970	488.7	438.726	1127.7	1106.98	4876.7	4843.97	5331.2	5108.33	1006.4	970.01	32.6916	32.0763
1971	454.6	455.504	1185.0	1153.44	5014.1	5075.17	5391.1	5275.00	1026.0	1003.86	33.3605	32.9111
1972	508.8	491.172	1244.9	1213.99	5540.6	5472.22	5568.1	5536.24	1089.1	1064.58	35.1264	32.9009
1973	481.1	489.216	1348.1	1285.68	6020.8	5804.93	5753.0	5744.01	1148.2	1114.55	36.1323	33.0458
1974	457.1	479.688	1394.7	1343.71	5783.7	5676.96	5750.7	5791.42	1067.3	1107.31	52.8960	48.8258
1975	500.8	484.928	1465.5	1389.05	4822.5	4760.48	5793.3	5752.62	937.3	932.40	52.4799	50.6579
1976	468.6	454.845	1486.6	1412.77	5514.8	5336.53	5908.2	5817.07	1107.7	1072.58	47.6478	48.6657
1977	491.6	475.569	1515.8	1459.74	5578.3	5656.05	6238.8	6015.03	1152.6	1141.77	41.7238	42.0409
1978	473.3	512.314	1505.4	1498.10	6016.5	5977.69	6137.8	6132.36	1153.6	1187.04	34.8627	36.5668
1979	529.2	516.949	1500.9	1531.67	6086.2	6239.46	6044.6	6162.52	1247.4	1214.86	37.2960	36.0244

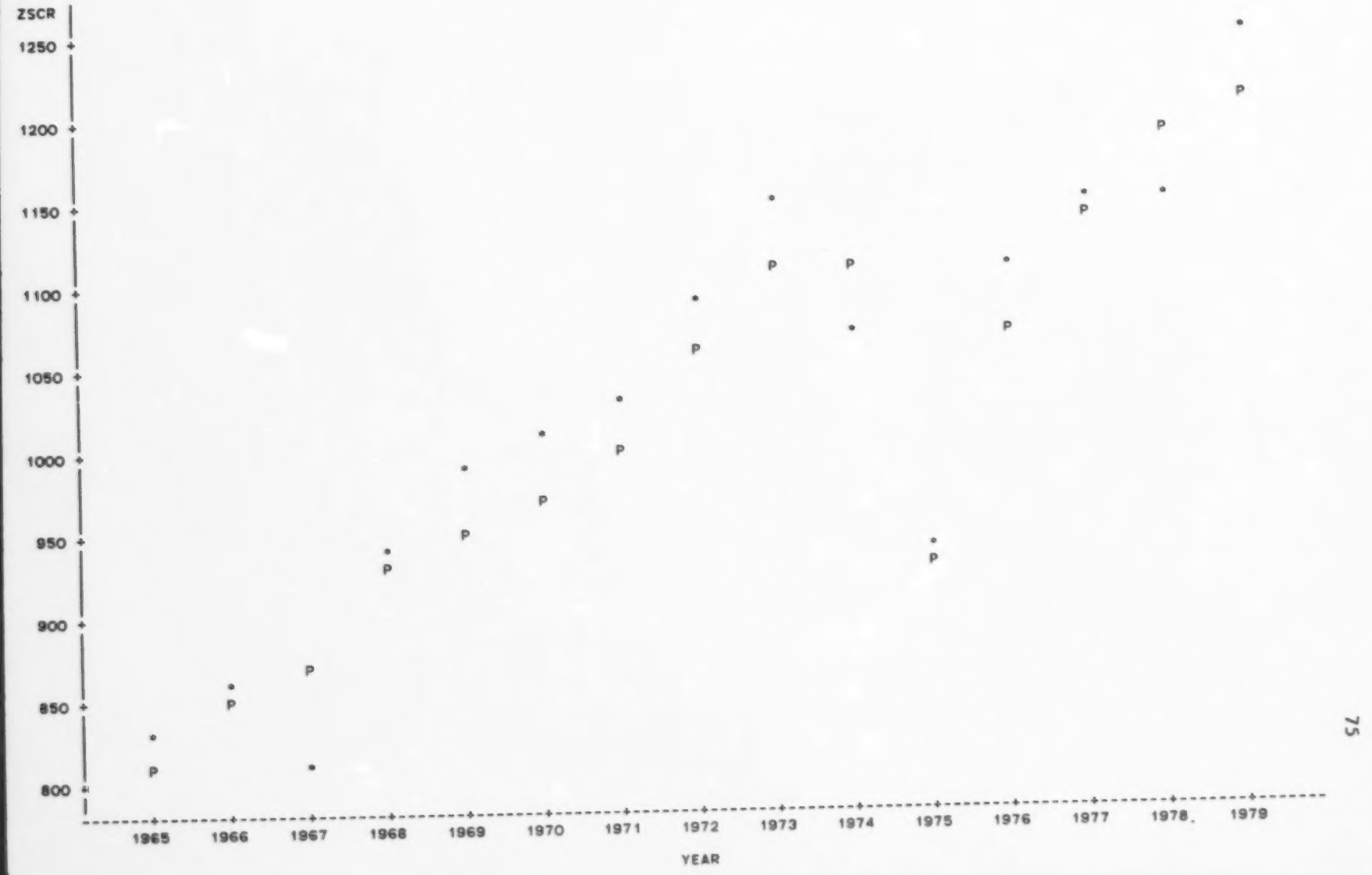
WORLD ZINC PRIMARY PRODUCTION

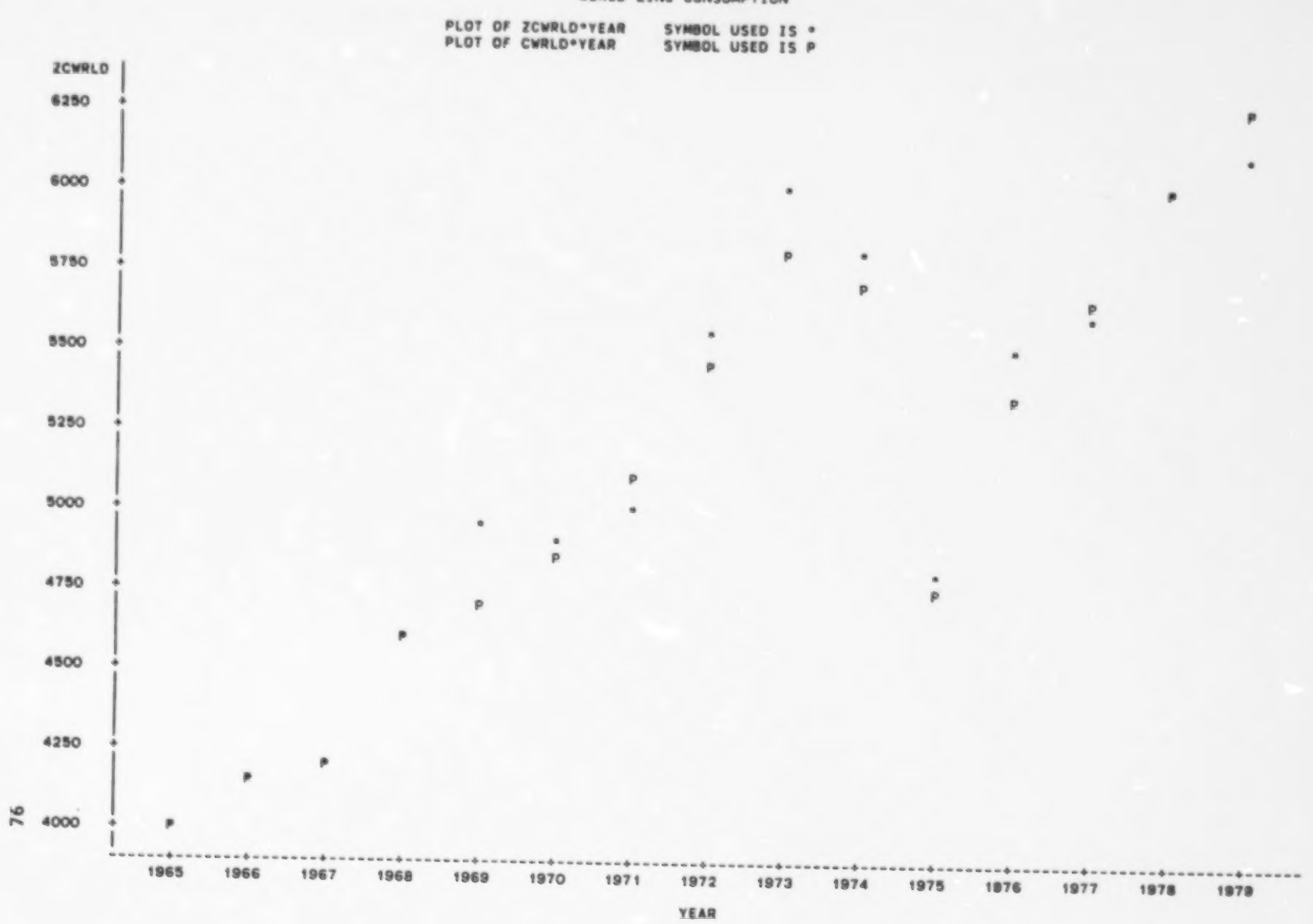
PLOT OF ZPWRLD*YEAR SYMBOL USED IS *
PLOT OF PWRLD*YEAR SYMBOL USED IS P

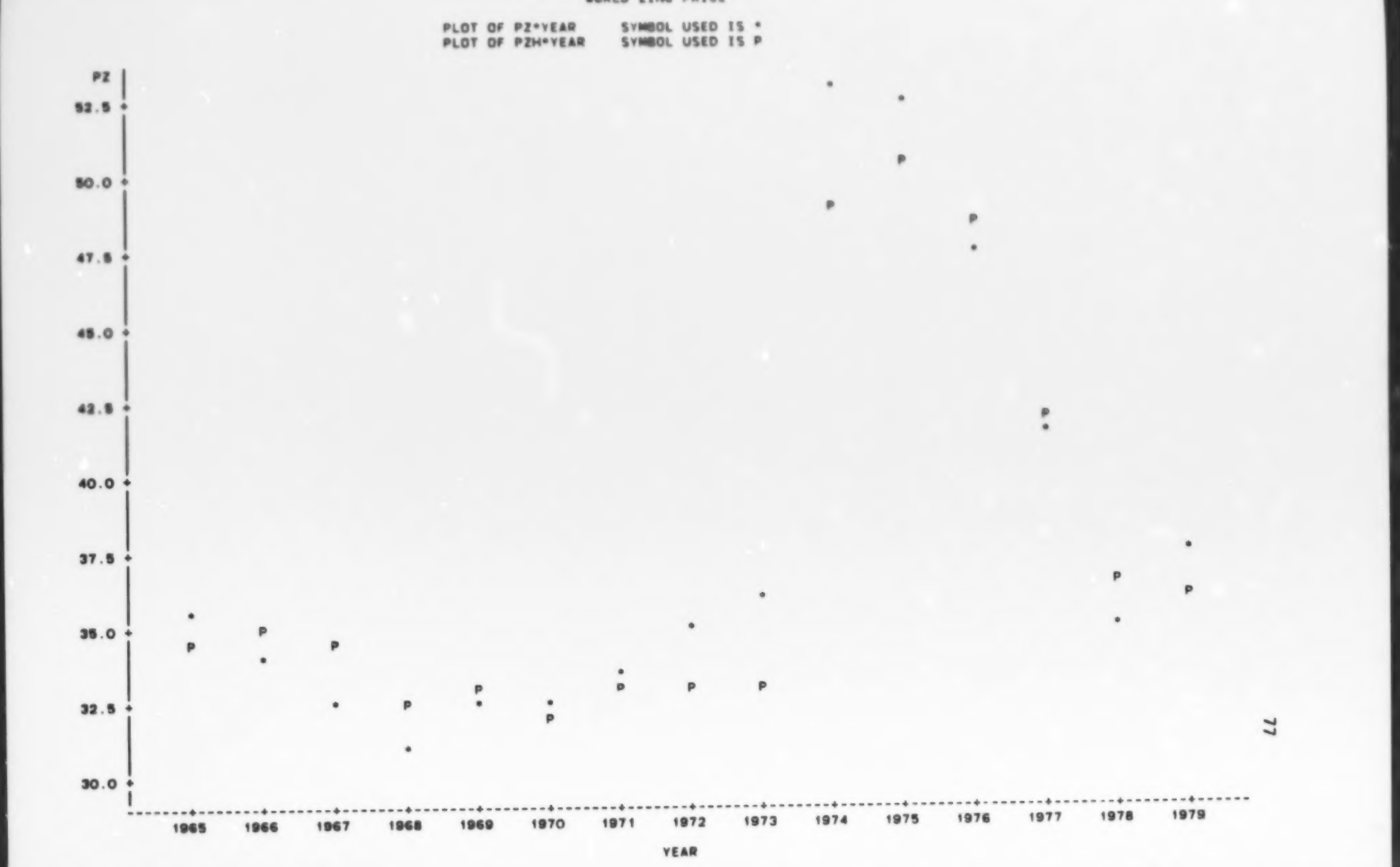


ZINC SECONDARY PRODUCTION

PLOT OF ZSCR*YEAR SYMBOL USED IS *
PLOT OF SCR*YEAR SYMBOL USED IS P




WORLD ZINC CONSUMPTION
PLOT OF ZCWRLD*YEAR SYMBOL USED IS *
PLOT OF CWRLD*YEAR SYMBOL USED IS P
ZCWRLD
6250
6000
5750
5500
5250
5000
4750
4500
4250
4000
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR


WORLD ZINC PRICE
PLOT OF PZ*YEAR SYMBOL USED IS *
PLOT OF PZH*YEAR SYMBOL USED IS P
PZ
52.5
50.0
47.5
45.0
42.5
40.0
37.5
35.0
32.5
30.0
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
YEAR

EVALUATION OF IN-SAMPLE PREDICTIONS -- ZINC

FUNCTION	ME	MPE	RMSE	RMSPE
CNA	-3.329	-0.001392	49.322	0.0385919
CSA	0.155	0.001553	5.164	0.0252935
CAS	-12.741	-0.008052	56.156	0.0756951
CAF	-0.809	0.002632	6.470	0.0913029
CEU	4.947	0.004575	43.379	0.0292172
COC	0.496	0.004989	4.120	0.0384340
CCP	-34.269	-0.028625	49.565	0.0403282
PNA	23.704	0.016191	64.930	0.0401025
PSA	3.806	0.016371	46.279	0.0641423
PAS	-18.279	-0.046718	32.487	0.0818964
PAF	-0.623	0.000692	13.730	0.0514099
PEU	5.145	0.014928	37.314	0.0621421
POC	-6.937	-0.009167	36.419	0.0714377
PCP	-28.610	-0.021663	41.528	0.0301791
SCR	-9.045	-0.007731	30.799	0.0311576
CWRLD	-45.554	-0.008546	119.457	0.0220429
PWRLD	-21.796	-0.002450	128.636	0.0247901
PRICE	-0.480	-0.009603	1.772	0.0441104

Simulation Equations

On the basis of in-sample predictions and some future simulations, we selected the most appropriate forms for the equations to be included in the simulation model. The resulting equations are displayed in the following tables.

SIMULATION EQUATIONS - PRIMARY PRODUCTION - ZINC

VARIABLE	NA	SA	AS	AF	EU	OC	CP
CONSTANT	-1632.3031	-64.7449	-217.2197	172.8918	-53.9699	-109.3551	-123.5317
PZ	.	.	2.3010	.	.	.	.
PZLAG	20.4601	6.9791	1.0979	0.5967	6.4073	0.3460	7.2646
PZLAG2	.	.	.	.	.	.	.
ROWSLAG	-0.0546	.	.	.	.	.	.
D	0.2073	0.0476	0.0022	.	0.0581	0.0030	0.0416
DLAG	0.0899	.	-0.0014	0.0068	-0.0481	0.0334	0.0406
DLAG2	.	.	.	.	.	.	.
T	23.6679	.	4.1210	-1.1125	.	4.7217	0.1300
R	-36.7165	.	.	.	-10.0202	-21.1530	.
RLAG	20.4268	.	.	.	-1.2401	11.6799	.
PASTPROD	-0.0394	.	.	.	.	.	.
LAGPROD	0.6201	0.6569	0.6589	0.4641	1.0172	0.2575	0.6874

SIMULATION EQUATIONS - SECONDARY PRODUCTION - ZINC

VARIABLE	WORLD
CONSTANT	24.0660
PZ	2.0695
PZLAG	3.6935
PZLAG2	.
D	.
DLAG	.
DLAG2	.
DLAG3	.
LAGSCR	0.5930
WD	0.1538
WDLAG	-0.0940

SIMULATION EQUATIONS - CONSUMPTION - ZINC

VARIABLE	NA	SA	AS	AF	EU	OC	CP
CONSTANT	-284.1957	-271.6136	-63.3329	-67.5377	-461.9897	-101.3741	6.8382
PZPS	.	.	.	.	.	.	.
PZPSLAG	-0.1992	-0.3217	.	.	-3.5502	-0.5138	.
PZPSLAG2	.	.	.	.	.	.	.
INVENLAG	.	.	.	.	.	.	.
Y	3912.1253	275.3335	1671.2738	54.9771	2578.5596	80.8690	976.3227
YLAG	-3358.2239	106.2350	-1310.1087	55.2746	-1292.0310	58.7264	-792.6116
KGLAG	-696.3862	.	.	.	527.5041	41.4173	.
MGLAG	.	.	.	.	.	.	.
LAGCON	0.5432	0.0506	0.5419	0.4645	0.0269	-0.0500	0.8136

SIMULATION EQUATIONS - PRICE - ZINC

VARIABLE	WORLD
CONSTANT	4.5626
PZLAG	0.5872
PZLAG2	-0.1674
INVENLAG	-0.0013
SUPPLY	.
T	.
Y	.
R	.
PS	0.0418
PSLAG	-0.1382
PSLAG2	0.1583

PART II

Revisions to the Simulation Program

The revision of the computer simulation model was accomplished according to the procedures outlined in Appendix B of World Mineral Markets, Stage III (pp. 155-159). To aid the user, we have annotated the printout presented in that publication with the changes. The printout is provided as the appendix to this report. All changes are displayed on the facing page. Once the new estimates were obtained, the computer model was updated in the following manner:

1. Approximate 1980 values for income, the interest rate, the rate of growth of the capital stock, and the rate of growth of the money supply were entered in the EXPARM array (see page A-32).
2. The rates of growth of income, the interest rate, the capital stock, and the money supply for the period 1962-1979 were calculated as follows (in percentages).

	Income	Capital	Interest Rate	Money Supply
NA	2.92	3.80	5.11	5.33
SA	3.49	6.92	N/A	N/A
AS	4.93	10.51	N/A	N/A
AF	2.58	7.14	N/A	N/A
EU	3.30	3.69	3.16	9.09
OC	2.69	3.55	4.06	7.98
CP	5.43	N/A	N/A	N/A

and were entered in the DOTVAR array (see page A-32).

3. The 1980 and 1979 prices (in 1967 U.S. dollars) for the mineral and the related commodity were entered in the PRICE array (see page A-32).

4. The rates of change in the price of the related commodities for the period 1962-79 were calculated (in percentages) as follows

Aluminum	-0.10
Copper	2.64
Steel	2.47

and entered in the PRDOT array (see page A-31).

5. Consumption data (by country group) for 1980, 1979, and 1978 were entered in the QDEM arrays for each mineral (see pages A-32 and A-33).

6. Primary production data (by country group) for 1980 were entered in the QSUP arrays for each mineral (see page A-32).

7. Secondary production data (by country group when appropriate) for 1980 were entered in the QSCP arrays for each mineral (see page A-32).

8. Cumulative production data (by country group) for 1980 were entered in the QSPRD arrays for each mineral (see page A-32).

9. The coefficients for the simulation equations were entered in the appropriate arrays using the table on page 159 of World Mineral Markets, Stage III as a guide to location.

   a. Primary production coefficients are contained in the SP arrays (see pages A-29 and A-30).

   b. Demand coefficients are contained in the DM arrays (see pages A-30 and A-31).

   c. Secondary production coefficients are contained in the SR arrays (see page A-31).

   d. Price coefficients are contained in the PRCF arrays (see page A-31).

10. The default parameters were changed so as to begin the forecasts in 1982 (see page A-33).

11. Since the modified-nickel model is no longer relevant, we eliminated this option. The changes appear on pages A-2 and A-11. If this option is selected (i.e., if IMINRL is set equal to 5 on the control card), the following statement will be printed.

> The modified nickel model is no longer relevant. Use the normal nickel model (IMINRL = 3). For more complete information, see the report on the update of the OMNR model.

Note that in the simulation model prices continue to be expressed in 1979 U.S. dollars. To alter this, one can change the value of WPI in the data block (see page A-28, BLCK149).

In the following we present a "base case" forecast for each of the mineral commodities in which the exogenous variables follow historical trend. Also, given our comments concerning aluminum, we present a simulation assuming that South American production is 5% below that which would otherwise be forthcoming.

COPPER

ASSUMPTIONS

RATES OF CHANGE

	INCOME	INTEREST RATE	MONEY GROWTH RATE	CAPITAL ACQUISITION
NORTH AMERICA	2.92	5.11	5.33	3.80
SOUTH AMERICA	3.49	00.00	0.00	6.92
ASIA	4.93	00.00	0.00	10.51
AFRICA	2.58	00.00	0.00	7.14
EUROPE	3.30	3.16	9.09	3.69
OCEANIA	2.69	4.06	7.98	3.55
CENTRAL PLANNED	5.43	00.00	0.00	00.00

SUBSTITUTE METAL -- ALUMINUM

RATE OF PRICE CHANGE -0.10

	NORTH AMERICA		SOUTH AMERICA		ASIA		AFRICA		EUROPE		OCEANIA		CENTRALLY PLANNED	
YEAR	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND
1982	1887.1	2564.1	1667.4	496.4	519.2	1811.3	1338.6	143.7	175.5	3140.2	421.1	156.8	1868.3	2238.2
1983	1727.8	2694.9	1733.6	520.8	520.2	1919.5	1332.4	157.0	175.9	3264.6	425.2	168.3	1922.5	2347.0
1984	1590.7	2799.7	1803.8	544.9	518.4	2030.2	1333.6	170.0	175.8	3373.1	428.4	179.2	1977.3	2458.7
1985	1504.0	2891.7	1874.1	569.8	517.3	2145.7	1339.6	182.7	176.1	3475.4	431.4	189.7	2033.5	2574.8
1986	1465.1	2978.3	1946.8	596.5	518.7	2267.6	1347.9	195.3	176.6	3581.2	434.4	199.7	2090.4	2696.4
1987	1464.5	3063.7	2023.6	624.8	523.1	2396.1	1356.8	207.9	177.2	3693.7	437.6	209.5	2147.3	2824.5
1988	1493.7	3149.8	2104.5	654.6	530.4	2531.1	1365.2	220.5	178.0	3812.0	441.0	219.1	2204.1	2959.8
1989	1544.7	3237.7	2189.0	685.6	540.7	2672.7	1371.9	233.1	179.0	3934.9	444.6	228.7	2260.6	3103.0
1990	1609.3	3327.8	2276.8	717.8	553.5	2821.3	1376.0	245.8	180.0	4062.0	448.3	238.3	2317.0	3254.4
1991	1679.8	3420.3	2368.1	751.2	568.5	2977.3	1377.2	258.6	181.2	4193.7	452.2	248.0	2373.0	3414.6

SECONDARY PRODUCTION

YEAR	NORTH AMERICA	SOUTH AMERICA	ASIA	AFRICA	EUROPE	OCEANIA	CENTRALLY PLANNED
1982	505.6	57.0	165.5	0.0	452.1	40.4	N/A
1983	538.3	60.7	176.4	0.0	473.1	41.5	N/A
1984	572.8	65.2	186.6	0.0	496.9	43.0	N/A
1985	603.4	70.8	196.5	0.0	519.8	45.5	N/A
1986	630.9	76.9	206.6	0.0	540.2	48.2	N/A
1987	657.2	83.6	217.2	0.0	558.8	50.6	N/A
1988	683.2	90.6	228.5	0.0	576.9	52.8	N/A
1989	709.2	98.0	240.3	0.0	595.3	55.0	N/A
1990	735.3	105.9	252.7	0.0	614.2	57.3	N/A
1991	761.6	114.1	265.7	0.0	633.6	59.6	N/A

WORLD

YEAR	PRODUCTION	SCRAP	CONSUMPTION	PRICE
1982	7877.2	1220.7	10550.8	73.331
1983	7837.5	1289.8	11072.1	74.301
1984	7828.0	1364.5	11555.8	77.367
1985	7876.0	1436.0	12029.7	79.140
1986	7980.0	1502.8	12515.1	79.576
1987	8130.3	1567.3	13020.3	79.629
1988	8317.0	1632.1	13547.0	79.744
1989	8530.4	1698.0	14095.6	79.882
1990	8760.9	1765.4	14667.4	79.942
1991	9000.0	1834.7	15263.7	79.932

ALUMINUM

ASSUMPTIONS

RATES OF CHANGE

	INCOME	INTEREST RATE	MONEY GROWTH RATE	CAPITAL ACQUISITION
NORTH AMERICA	2.92	5.11	5.33	3.80
SOUTH AMERICA	3.49	00.00	0.00	6.92
ASIA	4.93	00.00	0.00	10.51
AFRICA	2.58	00.00	0.00	7.14
EUROPE	3.30	3.16	9.0	3.69
OCEANIA	2.69	4.06	7.98	3.55
CENTRAL PLANNED	5.43	00.00	0.00	00.00

SUBSTITUTE METAL -- COPPER

RATE OF PRICE CHANGE 2.64

	NORTH AMERICA		SOUTH AMERICA		ASIA		AFRICA		EUROPE		OCEANIA		CENTRALLY PLANNED	
YEAR	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND
1982	6165.7	6340.0	1039.8	677.0	1703.9	2930.7	506.3	183.3	3837.5	3943.6	520.8	239.6	3403.9	3296.5
1983	6599.6	6666.9	1164.5	725.0	1811.6	3184.3	543.6	191.7	4018.4	4130.8	542.7	252.6	3543.1	3500.3
1984	6974.4	7000.0	1302.1	771.8	1935.7	3433.1	582.5	200.5	4221.8	4324.8	567.0	266.0	3706.9	3715.1
1985	7317.5	7342.4	1454.0	819.1	2074.3	3683.0	623.2	209.7	4442.2	4525.3	593.5	279.7	3877.0	3941.5
1986	7647.6	7694.6	1621.9	867.4	2226.4	3938.2	665.5	219.2	4676.4	4732.8	621.8	293.8	4049.2	4179.8
1987	7974.4	8057.0	1807.6	917.2	2391.2	4201.3	709.6	229.0	4922.6	4947.1	651.9	308.3	4224.2	4430.7
1988	8302.4	8429.9	2012.8	968.6	2567.9	4474.5	755.5	239.1	5179.8	5168.6	683.7	323.1	4403.4	4694.9
1989	8634.0	8813.7	2239.8	1021.6	2756.2	4759.4	803.3	249.5	5447.4	5397.4	717.2	338.4	4588.1	4973.3
1990	8970.2	9208.6	2490.7	1076.2	2955.8	5057.0	852.9	260.1	5725.5	5633.6	752.6	354.1	4779.0	5266.8
1991	9312.0	9615.1	2768.3	1132.6	3166.4	5368.6	904.5	270.8	6014.1	5877.5	789.8	370.1	4977.0	5576.1

SECONDARY PRODUCTION

YEAR	NORTH AMERICA	SOUTH AMERICA	ASIA	AFRICA	EUROPE	OCEANIA	CENTRALLY PLANNED
1982	1889.9	100.6	953.5	19.6	1310.7	36.9	N/A
1983	2001.4	109.1	1025.7	21.0	1372.3	38.2	N/A
1984	2118.5	116.6	1097.7	22.2	1435.2	40.7	N/A
1985	2240.3	124.0	1171.2	23.3	1500.1	43.4	N/A
1986	2366.7	131.5	1247.4	24.4	1567.2	46.0	N/A
1987	2497.5	139.3	1326.9	25.5	1636.7	48.5	N/A
1988	2632.8	147.3	1410.2	26.7	1708.6	51.0	N/A
1989	2772.7	155.6	1497.8	27.8	1782.8	53.5	N/A
1990	2917.0	164.2	1589.8	29.0	1859.6	56.1	N/A
1991	3066.0	173.1	1686.5	30.1	1938.8	58.7	N/A

WORLD

YEAR	PRODUCTION	SCRAP	CONSUMPTION	PRICE
1982	17177.9	4311.3	17610.7	59.386
1983	18223.5	4567.6	18651.7	58.950
1984	19290.3	4830.9	19711.3	58.665
1985	20381.6	5102.3	20800.6	58.460
1986	21509.0	5383.2	21925.7	58.297
1987	22681.5	5674.4	23090.6	58.154
1988	23905.6	5976.6	24298.8	58.017
1989	25185.9	6290.3	25553.1	57.879
1990	26526.7	6615.7	26856.3	57.734
1991	27932.1	6953.2	28210.8	57.579

NICKEL

ASSUMPTIONS

RATES OF CHANGE

	INCOME	INTEREST RATE	MONEY GROWTH RATE	CAPITAL ACQUISITION
NORTH AMERICA	2.92	5.11	5.33	3.80
SOUTH AMERICA	3.49	00.00	0.00	6.92
ASIA	4.93	00.00	0.00	10.51
AFRICA	2.58	00.00	0.00	7.14
EUROPE	3.30	3.16	9.09	3.69
OCEANIA	2.69	4.06	7.98	3.55
CENTRAL PLANNED	5.43	00.00	0.00	00.00

SUBSTITUTE METAL -- STEEL

RATE OF PRICE CHANGE 2.47

	NORTH AMERICA		SOUTH AMERICA		ASIA		AFRICA		EUROPE		OCEANIA		CENTRALLY PLANNED	
YEAR	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND
1982	219.6	188.3	31.7	13.0	109.8	148.8	65.6	7.3	30.2	235.9	208.9	5.4	207.7	182.1
1983	222.4	195.1	31.9	13.4	123.2	157.0	70.0	7.6	34.0	248.0	218.1	5.7	213.7	189.0
1984	225.6	203.3	32.3	14.0	134.1	165.6	74.6	7.9	38.0	261.3	227.6	6.1	220.0	196.5
1985	229.5	212.3	33.0	14.5	143.0	174.7	79.3	8.3	42.5	275.4	237.9	6.5	226.6	204.5
1986	234.5	222.0	33.7	15.1	150.3	184.1	84.0	8.6	47.5	290.0	248.8	6.9	233.5	213.0
1987	240.8	231.9	34.5	15.7	156.6	194.1	88.8	9.0	53.2	305.0	260.4	7.3	240.6	221.8
1988	248.3	242.2	35.4	16.3	162.2	204.5	93.6	9.3	59.5	320.3	272.7	7.8	247.9	231.0
1989	256.8	252.6	36.3	17.0	167.4	215.4	98.5	9.7	66.5	336.1	285.5	8.2	255.4	240.7
1990	266.1	263.2	37.2	17.6	172.2	226.9	103.3	10.1	74.3	352.2	298.9	8.6	263.1	250.8
1991	276.1	274.1	38.1	18.3	177.0	238.9	108.3	10.4	83.0	368.9	312.8	9.1	270.9	261.4

WORLD

YEAR	PRODUCTION	SCRAP	CONSUMPTION	PRICE
1982	873.5	18.4	780.9	322.146
1983	913.3	20.6	815.9	324.409
1984	952.3	22.1	854.6	325.338
1985	991.7	23.4	896.1	326.170
1986	1032.4	24.6	939.6	327.438
1987	1074.9	26.0	984.7	329.318
1988	1119.5	27.4	1031.4	331.799
1989	1166.2	28.9	1079.6	334.794
1990	1215.1	30.5	1129.5	338.198
1991	1266.2	32.2	1181.1	341.914

ZINC

ASSUMPTIONS

RATES OF CHANGE

	INCOME	INTEREST RATE	MONEY GROWTH RATE	CAPITAL ACQUISITION
NORTH AMERICA	2.92	5.11	5.33	3.60
SOUTH AMERICA	3.49	00.00	0.00	6.92
ASIA	4.93	00.00	0.00	10.51
AFRICA	2.58	00.00	0.00	7.14
EUROPE	3.30	3.16	9.09	3.69
OCEANIA	2.69	4.06	7.98	3.55
CENTRAL PLANNED	5.43	00.00	0.00	00.00

SUBSTITUTE METAL -- STEEL

RATE OF PRICE CHANGE 2.47

	NORTH AMERICA		SOUTH AMERICA		ASIA		AFRICA		EUROPE		OCEANIA		CENTRALLY PLANNED	
YEAR	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND
1982	1425.9	1147.9	1035.0	383.5	466.3	1377.1	247.1	156.1	955.8	1819.7	516.8	128.8	1565.1	1741.0
1983	1570.9	1221.1	1079.1	405.9	501.9	1469.2	251.9	164.8	983.8	1885.3	535.9	133.9	1663.7	1836.5
1984	1735.3	1287.1	1133.4	429.4	532.0	1557.9	256.1	172.9	1018.8	1956.3	553.7	139.6	1769.8	1936.5
1985	1891.7	1350.2	1189.8	454.0	557.1	1646.6	259.7	180.9	1056.9	2032.3	570.8	145.8	1876.2	2041.6
1986	2032.7	1412.5	1245.9	479.5	578.3	1737.4	262.9	189.0	1096.1	2111.9	587.7	152.3	1981.4	2152.0
1987	2160.6	1475.2	1302.1	505.9	597.2	1831.3	265.9	197.2	1136.3	2194.2	604.7	159.0	2086.4	2268.1
1988	2279.9	1538.9	1359.7	533.2	614.8	1929.2	268.9	205.6	1178.0	2278.9	622.0	165.9	2193.0	2390.3
1989	2394.3	1604.1	1419.5	561.4	631.9	2031.6	272.2	214.2	1221.9	2366.0	639.6	172.9	2302.6	2519.0
1990	2506.4	1670.9	1482.1	590.6	648.8	2138.8	275.7	222.9	1268.6	2455.6	657.8	180.0	2416.1	2654.4
1991	2617.2	1739.5	1547.7	620.7	665.7	2251.2	279.4	231.9	1318.4	2547.9	676.4	187.4	2534.1	2797.1

WORLD

YEAR	PRODUCTION	SCRAP	CONSUMPTION	PRICE
1982	6212.1	1309.0	6754.0	42.270
1983	6587.1	1365.7	7116.6	44.979
1984	6999.1	1426.3	7478.7	46.008
1985	7402.2	1487.1	7851.3	46.280
1986	7765.0	1547.7	8234.5	46.453
1987	8153.1	1609.2	8631.0	46.804
1988	8516.2	1672.7	9042.1	47.371
1989	8882.0	1738.9	9469.1	48.101
1990	9255.3	1808.2	9913.3	48.935
1991	9638.9	1880.8	10375.8	49.836

ALUMINUM

ASSUMPTIONS

RATES OF CHANGE

	INCOME	INTEREST RATE	MONEY GROWTH RATE	CAPITAL ACQUISITION
NORTH AMERICA	2.92	5.11	5.33	3.80
SOUTH AMERICA	3.49	00.00	0.00	6.92
ASIA	4.93	00.00	0.00	10.51
AFRICA	2.58	00.00	0.00	7.14
EUROPE	3.30	3.16	9.09	3.69
OCEANIA	2.69	4.06	7.98	3.55
CENTRAL PLANNED	5.43	00.00	0.00	00.00

SUBSTITUTE METAL -- COPPER

RATE OF PRICE CHANGE 2.64

THE FOLLOWING EXTERNAL SHOCK EFFECTS HAVE BEEN USED.

COUNTRY GROUP	PERCENTAGE EQUATION	SHIFT	INITIAL YEAR	FINAL YEAR
SOUTH AMERICA	SUPPLY	-5.00	81	92

	NORTH AMERICA		SOUTH AMERICA		ASIA		AFRICA		EUROPE		OCEANIA		CENTRALLY PLANNED	
YEAR	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND	SUPPLY	DEMAND
1982	6180.3	6339.9	939.1	677.5	1703.9	2930.7	506.3	183.5	3837.0	3943.8	520.1	239.6	3397.5	3295.9
1983	6636.8	6666.7	1000.5	726.3	1811.7	3184.3	543.6	192.4	4016.9	4131.5	540.7	252.6	3528.6	3498.5
1984	7039.4	6999.6	1064.6	774.1	1935.8	3433.1	582.6	201.9	4218.9	4325.9	563.2	266.0	3683.6	3711.8
1985	7414.1	7341.8	1131.8	822.4	2074.5	3683.0	623.3	211.8	4437.7	4527.1	587.5	279.8	3843.9	3936.2
1986	7780.1	7693.8	1202.2	872.0	2226.7	3938.2	665.8	222.4	4669.8	4735.2	613.4	293.9	4005.0	4172.1
1987	8147.4	8056.0	1276.2	923.3	2391.6	4201.3	710.0	233.4	4913.5	4950.4	640.5	308.4	4167.2	4420.2
1988	8521.0	8428.6	1353.8	976.4	2568.5	4474.5	756.0	245.0	5167.7	5172.8	669.0	323.3	4331.9	4681.1
1989	8903.9	8812.0	1435.3	1031.3	2757.1	4759.4	803.9	257.0	5431.9	5402.6	698.8	338.6	4499.9	4955.7
1990	9298.1	9206.6	1520.9	1088.2	2956.9	5057.0	853.8	269.6	5706.0	5640.1	729.9	354.3	4671.9	5244.6
1991	9704.9	9612.7	1610.8	1147.1	3167.9	5368.6	905.6	282.6	5990.1	5885.4	762.4	370.4	4848.3	5548.8

SECONDARY PRODUCTION

YEAR	NORTH AMERICA	SOUTH AMERICA	ASIA	AFRICA	EUROPE	OCEANIA	CENTRALLY PLANNED
1982	1890.0	100.8	953.5	19.7	1310.8	36.9	N/A
1983	2001.6	109.3	1025.7	21.0	1372.5	38.2	N/A
1984	2119.1	117.0	1097.7	22.3	1435.6	40.7	N/A
1985	2241.3	124.6	1171.3	23.5	1500.7	43.4	N/A
1986	2368.1	132.3	1247.5	24.7	1568.1	46.0	N/A
1987	2499.5	140.4	1327.0	25.9	1638.0	48.5	N/A
1988	2635.6	148.7	1410.4	27.1	1710.2	51.0	N/A
1989	2776.2	157.4	1498.1	28.4	1784.9	53.6	N/A
1990	2921.6	166.4	1590.2	29.8	1862.1	56.2	N/A
1991	3071.7	175.6	1687.1	31.2	1942.0	58.8	N/A

WORLD

YEAR	PRODUCTION	SCRAP	CONSUMPTION	PRICE
1982	17084.1	4311.6	17611.0	59.397
1983	18078.8	4568.4	18652.4	58.981
1984	19088.0	4832.4	19712.4	58.722
1985	20112.8	5104.7	20802.2	58.549
1986	21162.9	5386.7	21927.6	58.422
1987	22246.4	5679.2	23093.0	58.322
1988	23368.0	5983.1	24301.7	58.235
1989	24530.3	6298.6	25556.6	58.153
1990	25737.5	6626.2	26860.4	58.074
1991	26990.2	6966.3	28215.6	57.994

APPENDIX

Simulation Program Listing

```
//$OPTIONS     NOLIST                                                    A 1
C*************************************************************************
C                                                                        *
C         MAIN PROGRAM                                                   *
C                                                                        *
C          THE MAIN PROGRAM READS AND PROCESSES USER ALTERATIONS TO THE  *
C    FOLLOWING:                                                          *
C                                                                        *
C    1. PRINT OPTIONS                                                    *
C    2. PLOT OPTIONS                                                     *
C    3. GROWTH RATES OF EXOGENEOUS VARIABLES                             *
C    4. EXOGENEOUS SHOCKS TO SIMULATED DATA.                             *
C    5. EXTRA COUNTRY GROUPS                                             *
C                                                                        *
C          IT THEN ITERATES TO OBTAIN SIMULATED VALUES FOR               *
C    THE MINERAL PRICE, DEMAND, SCRAP PRODUCTION, AND                    *
C    PRIMARY PRODUCTION.  IN ADDITION IT CALCULATES THE WORLD            *
C    TOTALS FOR THESE VARIABLES.                                         *
C                                                                        *
C          MAIN THEN MAKES CALLS TO CRTPRT AND LINPRT FOR                *
C    PRINTING, AND MAKES CALLS TO PLOT FOR PLOTTING.                     *
C                                                                        *
C*************************************************************************
      COMMON / ARPRIC / PRICE(2,3,4)                                     MAIN001
      COMMON / AREOUT / OUTPUT (4,11,25), DOTVAR (4,10), PROOT (4),      MAIN002
     1 ICNT(25), IGRT(25), USRGRT(25), GROW(25)                          MAIN003
      COMMON / AREAPR / PRCOEF(15,4),PSHIFT(50),PRCHA(4)                 MAIN004
      COMMON / ARLEXP / EXPARM(2,4,10),WPI                               MAIN005
      COMMON / AREAGN / DMCOEF(15,10,4), SRCOEF(15,10,4),                MAIN006
     1 SPCOEF(15,10,4), SHFT(50,30)                                      MAIN007
      COMMON / AREDAT / QDEM(4,10,4), QSUP(2,10,4), QSCP(2,10,4),        MAIN008
     1      QSPROD(2,10,4)                                               MAIN009
      COMMON / AREANM / NAME (2,4),  NAMSUB (2,4),  NAMCNT (4,11),       MAIN010
     1  NAMEXT(2,5),NAMVAR(2,4), IYRSFT(20), SHIFT(20), ICTSHT(20),      MAIN011
     2  IVETL8(22,4),ISTAR,IBLANK,IMATCH,IBAR,IPLTVR(3,12),IPLTPR        MAIN012
      COMMON/ AREPRM/ ICNTRY, IYR, IPRICE, IQDEM, IQSUP, IQSCP, IYRSIM,  MAIN013
     1 IYRFST, NIKCHK,  IWORLD, IANN, IEXCHK, INEW(3), IERROR(14),IPG,   MAIN014
     2 ISVAR(20), ISLEN(20), KVAR(3), IEXTRA, CNEW(3,4), ISCALE(30)      MAIN015
      DIMENSION CHANGE(6,10)                                             MAIN016
      DIMENSION WORDEM(4,4), WORSUP(2,4), WORSCP(2,4), WSSUM(3,4)        MAIN017
      DIMENSION ROWS(3,10,4)                                             MAIN018
      DIMENSION NAM(4)                                                   MAIN019
        OPEN(UNIT=5,FILE='SIMTEX.IN',DEVICE='DSK',
        1 ACCESS='SEQIN',MODE='ASCII')
        OPEN(UNIT=6,FILE='SIMTEX.DAT',DEVICE='DSK',
        1 ACCESS='SEQOUT',MODE='ASCII')
      WRITE (6,1030)
      WRITE (6,1000)                                                     MAIN020
C*************************************************************************MAIN021
C                                                                        *
C     READ USER COMMANDS                                                 *
C                                                                        *
C     IMINRL = CODE # OF MINERAL TO SIMULATE                             *
C                 = 1 IF COPPER.                                         *
C                 = 2 IF ALUMINUM.                                       *
C                 = 3 IF NICKEL.                                         *
C                 = 4 IF ZINC.                                           *
C                 = 5 IF NICKEL-MODIFIED CASE.                           *
C     IPRTCT = CODE # OF PRINT OPTIONS                                   *
C                 = 0  IF ONLY CRT.                                      *
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C                  = 1  IF ONLY LINE PRINTER.                          *
C                  = 2  IF BOTH.                                       *
C     IPLOT  = # OF PLOT OPTION CARDS                                  *
C     IFSTYR = FIRST YEAR TO BE PRINTED.                               *
C     ISIMYR = # OF YEARS TO SIMULATE                                  *
C     IGROW  = # OF GROWTH RATES TO BE ALTERED                         *
C     ISHIFT = # OF EXOGENEOUS SHIFT CARDS.                            *
C     IEXTRA = # OF ADDITIONAL COUNTRY GROUPS.                         *
C                                                                      *
C              IGROW SHOULD BE 0(ZERO) IF NO OPTION                    *
C     CARDS ARE USED TO ALTER GROWTH RATES.                            *
C              ISHIFT SHOULD BE 0(ZERO) IF NO OPTION                   *
C     CARDS ARE USED TO SPECIFY EXOGENEOUS SHIFTS.                     *
C              IEXTRA SHOULD BE 0(ZERO) IF NO OPTION                   *
C     CARDS ARE USED TO SPECIFY ADDITIONAL COUNTRY GROUPS.             *
C                                                                      *
C     FORMAT  2I1,5I2,I1                                               *
C                                                                      *
C**********************************************************************
      READ (5,1000) IMINRL,IPRTCT,IPLOT,IFSTYR,ISIMYR,IGROW,ISHIFT,    MAIN022
     1 IEXTRA                                                          MAIN023
      WRITE (6,1080) IMINRL,IPRTCT,IPLOT,IFSTYR,ISIMYR,IGROW,ISHIFT,   MAIN024
     1 IEXTRA                                                          MAIN025
      IF (ISIMYR.NE.0) IYRSIM=ISIMYR                                   MAIN026
      IF (IFSTYR.NE.0) IYRFST=IFSTYR                                   MAIN027
      IF (IMINRL.LT.0.OR.IMINRL.GT.5) IERROR(1)=1                      MAIN028
      IF (IPRTCT.LT.0.OR.IPRTCT.GT.3) IERROR(2)=1                      MAIN029
      IF (IYRSIM.LT.0) IERROR(3)=1                                     MAIN030
      IF (IGROW.LT.0) IERROR(4)=1                                      MAIN031
      IF (ISHIFT.LT.0) IERROR(5)=1                                     MAIN032
      IF (IEXTRA.LT.0.OR.IEXTRA.GT.3) IERROR(6)=1                      MAIN033
      IF (IPLOT.LT.0) IERROR(8)=1                                      MAIN034
      IERR=0                                                           MAIN035
      DO 10 I=1,8                                                      MAIN036
         IF (IERROR(I).NE.0) IERR=1                                    MAIN037
   10 CONTINUE                                                         MAIN038
      IF (IERR.NE.0) GO TO 550                                         MAIN039
      IPG=IGROW+ISHIFT                                                 MAIN040
      IYRPLT=IYRFST-1                                                  MAIN041
      IYRFST=IYRFST-IYR+1                                              MAIN042
      IYRSIM=IYRSIM+IYRFST-1                                           MAIN043
      IYRMAX=IYR+IYRSIM-1                                              MAIN044
      ICNTRY=ICNTRY+IEXTRA                                             MAIN045
      IWORLD=ICNTRY+1                                                  MAIN046
      IF (IMINRL.NE.5) GO TO 20                                        MAIN047
C**********************************************************************
C                                                                      *
C              IF NICKEL-MODIFIED CASE IS BEING USED, RESET EQUATION   *
C     COEFFICEINTS TO APPROPRIATE VALUES.                              *
C                                                                      *
C**********************************************************************
        WRITE(6,1231)
        WRITE(6,1232)
        WRITE(6,1233)
        WRITE(6,1234)
        WRITE(6,1235)
        STOP
C     NIKCHK=1                                                         MAIN048
C     IMINRL=3                                                         MAIN049
C     SPCOEF(5,1,3)=SPCOEF(5,6,3)                                      MAIN050
```

```
C      SPCOEF(6,1,3)=SPCOEF(6,6,3)                                      MAIN051
C      SPCOEF(7,1,3)=SPCOEF(7,6,3)                                      MAIN052
C      DMCOEF(5,1,3)=0.0                                                MAIN053
C      DMCOEF(5,5,3)=0.0                                                MAIN054
C      DMCOEF(5,6,3)=0.0                                                MAIN055
C      PRCOEF(4,3)=-0.0292                                              MAIN056
   20 CONTINUE                                                          MAIN057
      IANN=IYR+1899                                                     MAIN058
      IF (IPLOT.EQ.0) GO TO 90                                          MAIN059
C*************************************************************************
C                                                                       *
C            IF PLOT OPTIONS HAVE BEEN CALLED FOR, READ                 *
C     PLOT OPTION CARDS.                                                *
C                                                                       *
C     IVAR   = INDEX OF VARIABLE TO PLOT                                *
C                = 0 IF ALL VARIABLES                                   *
C                = 1 IF PRIMARY PRODUCTION (SUPPLY)                     *
C                = 2 IF SECONDARY PRODUCTION (SCRAP)                    *
C                = 3 IF DEMAND                                          *
C                = 4 IF PRICE.                                          *
C     ICTPLT = INDEX OF COUNTRY GROUP TO PLOT                           *
C                = 0 IF WORLD                                           *
C                = 1 IF NORTH AMERICA                                   *
C                = 2 IF SOUTH AMERICA                                   *
C                = 3 IF ASIA                                            *
C                = 4 IF AFRICA                                          *
C                = 5 IF EUROPE                                          *
C                = 6 IF OCEANIA                                         *
C                = 7 IF CENTRALLY PLANNED                               *
C                = 8,9,10 FOR ADDITIONAL COUNTRY GROUPS                 *
C                = 12 FOR ALL COUNTRY GROUPS PLUS WORLD                 *
C                                                                       *
C     FORMAT  I2,I1                                                     *
C                                                                       *
C*************************************************************************
      DO 70 I=1,IPLOT                                                   MAIN060
         READ (5,1010) IVAR,ICTPLT                                      MAIN061
         WRITE (6,1070) IVAR,ICTPLT                                     MAIN062
         ICHECK=ICTPLT                                                  MAIN063
         IF (ICHECK.EQ.0) ICTPLT=IWORLD                                 MAIN064
         IF (ICHECK.EQ.12) ICTPLT=0                                     MAIN065
         IF (IVAR.EQ.0.OR.IVAR.EQ.4) IPLTPR=1                           MAIN066
         IF (IVAR.EQ.4) GO TO 70                                        MAIN067
         IF (IVAR.NE.0) GO TO 50                                        MAIN068
         DO 40 J=1,3                                                    MAIN069
            IF (ICTPLT.NE.0) IPLTVR(J,ICTPLT)=1                         MAIN070
            IF (ICTPLT.NE.0) GO TO 40                                   MAIN071
            DO 30 K=1,IWORLD                                            MAIN072
               IPLTVR(J,K)=1                                            MAIN073
   30       CONTINUE                                                    MAIN074
   40    CONTINUE                                                       MAIN075
         GO TO 70                                                       MAIN076
   50    CONTINUE                                                       MAIN077
         IF (ICTPLT.NE.0) IPLTVR(IVAR,ICTPLT)=1                         MAIN078
         IF (ICTPLT.NE.0) GO TO 70                                      MAIN079
         DO 60 K=1,IWORLD                                               MAIN080
            IPLTVR(IVAR,K)=1                                            MAIN081
   60    CONTINUE                                                       MAIN082
   70 CONTINUE                                                          MAIN083
      IPLTVR(2,7)=0                                                     MAIN084
```

```
      IF (IMINRL.LE.2) GO TO 90                                          MAIN085
      IPLTVR(2,4)=0                                                      MAIN086
      IF (IMINRL.EQ.1) GO TO 90                                          MAIN087
      DO 80 J=1,5                                                        MAIN088
         K=J                                                             MAIN089
         IF (J.GE.4) K=K+1                                               MAIN090
         IPLTVR(2,K)=0                                                   MAIN091
   80 CONTINUE                                                           MAIN092
   90 CONTINUE                                                           MAIN093
      IF (IGROW.EQ.0) GO TO 130                                          MAIN094
C*********************************************************************
C                                                                     *
C              READ GROWTH RATE OPTIONS IF CALLED                     *
C                                                                     *
C     ICNT   = INDEX FOR COUNTRY GROUP                                *
C              SEE PLOT OPTIONS ABOVE FOR VALUES                      *
C              NOTE THAT ICNT=12 IS NOT VALID HERE.                   *
C     IGRT   = INDEX OF EXOGENEOUS VARIABLE TO HAVE GROWTH ALTERED.   *
C                 = 1 IF INCOME                                       *
C                 = 2 IF INTEREST RATE                                *
C                 = 3 IF CAPITAL STOCK                                *
C                 = 4 IF MONEY STOCK                                  *
C                 = 5 IF PRICE OF RELATED GOOD.                       *
C     NOTE:   IF IGRT=5, THEN THE ONLY VALID VALUE FOR ICNT IS 0,     *
C          I.E. WORLD.                                                *
C     USRGRT = NEW GROWTH RATE VALUE                                  *
C          TO BE ENTERED AS PERCENTAGE, 10.0 NOT .10 FOR TEN PERCENT. *
C                                                                     *
C     FORMAT  2I1,2P14.6                                              *
C                                                                     *
C*********************************************************************
      READ (5,1020) (ICNT(I),IGRT(I),USRGRT(I),I=1,IGROW)               MAIN095
      WRITE (6,1090) (ICNT(I),IGRT(I),USRGRT(I),I=1,IGROW)              MAIN096
      DO 110 I=1,IGROW                                                  MAIN097
         IF (ICNT(I).LT.0.OR.ICNT(I).GT.ICNTRY) IERROR(9)=I             MAIN098
         IF (ICNT(I).EQ.0.AND.IGRT(I).NE.5) IERROR(10)=I                MAIN099
         IF (IGRT(I).LE.0.OR.IGRT(I).GE.6) IERROR(11)=I                 MAIN100
         J=IGRT(I)                                                      MAIN101
         K=ICNT(I)                                                      MAIN102
         IF (J.EQ.5) GO TO 100                                          MAIN103
         IF (J.EQ.4) USRGRT(I)=USRGRT(I)*100.0                          MAIN104
         DOTVAR(J,K)=USRGRT(I)                                          MAIN105
         IF (J.LE.2) GO TO 110                                          MAIN106
         EXPARM(2,J,K)=USRGRT(I)                                        MAIN107
         GO TO 110                                                      MAIN108
  100    PRDOT(IMINRL)=USRGRT(I)                                        MAIN109
  110 CONTINUE                                                          MAIN110
      DO 120 J=9,11                                                     MAIN111
         IF (IERROR(J).NE.0) IERR=1                                     MAIN112
  120 CONTINUE                                                          MAIN113
      IF (IERR.NE.0) GO TO 550                                          MAIN114
  130 CONTINUE                                                          MAIN115
C*********************************************************************
C                                                                     *
C              READ SHIFT OPTION CARDS IF CALLED                      *
C                                                                     *
C     IYRSFT = 2-DIGIT VALUE FOR FIRST YEAR OF SHIFT.                 *
C     ICTSHT = INDEX OF COUNTRY GROUP TO SHIFT                        *
C              SEE PLOT OPTIONS ABOVE FOR VALUE.                      *
C     NOTE:   NEITHER ICTSHT=0 NOR ICTSHT=12 ARE VALID.               *
```

```
C      ISVAR  = INDEX OF VARIABLE TO SHIFT.                              *
C               SEE PLOT OPTIONS ABOVE.                                  *
C      ISLEN  = # OF YEARS SHIFT WILL BE ACTIVE.                         *
C      SHIFT  = VALUE OF SHIFT---IN PERCENTAGE.                          *
C                                                                        *
C      FORMAT  2I2,I1,I2,2PF10.4                                         *
C                                                                        *
C*************************************************************************
      IF (ISHIFT.EQ.0) GO TO 180                                         MAIN116
      DO 170 I=1,ISHIFT                                                  MAIN117
         READ (5,1040) IYRSFT(I),ICTSHT(I),ISVAR(I),ISLEN(I),SHIFT(I)   MAIN118
         WRITE (6,1110) IYRSFT(I),ICTSHT(I),ISVAR(I),ISLEN(I),SHIFT(I)  MAIN119
         IYRS=IYRSFT(I)-IYR+1                                            MAIN120
         ILENGT=ISLEN(I)                                                 MAIN121
         IF (ILENGT.EQ.0) ILENGT=1                                       MAIN122
         ISTOP=IYRS+ILENGT-1                                             MAIN123
         IF (ISVAR(I).EQ.4) GO TO 150                                    MAIN124
         K=(KVAR(ISVAR(I))*10)+ICTSHT(I)                                 MAIN125
         DO 140 J=IYRS,ISTOP                                             MAIN126
            SHFT(J,K)=SHFT(J,K)+SHIFT(I)                                 MAIN127
  140    CONTINUE                                                        MAIN128
         GO TO 170                                                       MAIN129
  150    CONTINUE                                                        MAIN130
         DO 160 J=IYRS,ISTOP                                             MAIN131
            PSHIFT(J)=PSHIFT(J)+SHIFT(I)                                 MAIN132
  160    CONTINUE                                                        MAIN133
  170 CONTINUE                                                           MAIN134
  180 CONTINUE                                                           MAIN135
      IF (IEXTRA.EQ.0) GO TO 240                                         MAIN136
C*************************************************************************
C                                                                        *
C              READ EXTRA COUNTRY GROUP CARDS IF CALLED.                 *
C                                                                        *
C      ITYPE  = 0 IF BOTH DEMANDER AND SUPPLIER                          *
C               1 IF ONLY DEMANDER                                       *
C               2 IF ONLY SUPPLIER.                                      *
C      IYRST  = 2-DIGIT VALUE FOR YEAR COUNTRY ENTERS MARKET             *
C      AMT1   = INITIAL VALUE OF DEMAND IF DEMANDER OR BOTH DEMANDER     *
C                  AND SUPPLIER.                                         *
C             = INITIAL VALUE OF SUPPLY IF ONLY SUPPLIER.                *
C      GRT1   = GROWTH RATE OF AMT1 IN PERCENTAGE TERMS.                 *
C      NAM    = NAME OF NEW COUNTRY                                      *
C               MAY CONTAIN UP TO 16 ALPHANUMERIC CHARACTERS.            *
C      AMT2   = INITIAL VALUE OF SUPPLY IF BOTH DEMANDER AND SUPPLIER.   *
C      GRT2   = GROWTH RATE OF AMT2 IN PERCENTAGE TERMS.                 *
C                                                                        *
C      FORMAT  I1,I2,F10.4,2PF10.4,A16,F10.4,2PF10.4                     *
C                                                                        *
C*************************************************************************
      K=8+IEXTRA                                                         MAIN137
      DO 190 I=1,4                                                       MAIN138
         NAMCNT(I,K)=NAMCNT(I,8)                                         MAIN139
  190 CONTINUE                                                           MAIN140
      DO 230 I=1,IEXTRA                                                  MAIN141
         IF (IERROR(12).NE.0) GO TO 220                                  MAIN142
         READ (5,1030) ITYPE,IYRST,AMT1,GRT1,(NAM(J),J=1,4),AMT2,GRT2    MAIN143
         WRITE (6,1100) ITYPE,IYRST,AMT1,GRT1,(NAM(J),J=1,4),AMT2,GRT2   MAIN144
         INEW(I)=IYRST                                                   MAIN145
         IF (IYRST.LT.IYR.OR.IYRST.GT.IYRMAX) IERROR(12)=IYRST           MAIN146
         K=7+I                                                           MAIN147
```

```
      DO 200 J=1,4                                                    MAIN148
         NAMCNT(J,K)=NAM(J)                                           MAIN149
  200 CONTINUE                                                        MAIN150
      IF (ITYPE.EQ.2) GO TO 210                                       MAIN151
      CNEW(I,1)=AMT1                                                  MAIN152
      CNEW(I,2)=GRT1                                                  MAIN153
      IF (ITYPE.EQ.1) GO TO 220                                       MAIN154
      CNEW(I,3)=AMT2                                                  MAIN155
      CNEW(I,4)=GRT2                                                  MAIN156
      GO TO 220                                                       MAIN157
  210 CONTINUE                                                        MAIN158
      CNEW(I,3)=AMT1                                                  MAIN159
      CNEW(I,4)=GRT1                                                  MAIN160
  220 CONTINUE                                                        MAIN161
  230 CONTINUE                                                        MAIN162
      IF (IERROR(12).NE.0) GO TO 550                                  MAIN163
  240 CONTINUE                                                        MAIN164
C*****************************************************************
C                                                                    *
C     CALCULATE RATE OF CHANGE MULTIPLIER                            *
C                                                                    *
C*****************************************************************
      DO 250 I=1,2                                                    MAIN165
      DO 250 J=1,ICNTRY                                               MAIN166
         CHANGE(I,J)=1.0+DOTVAR(I,J)                                  MAIN167
  250 CONTINUE                                                        MAIN168
      PFCHA(IMINRL)=1.0+PFDOT(IMINRL)                                 MAIN169
      DO 260 I=3,4                                                    MAIN170
      DO 260 J=1,ICNTRY                                               MAIN171
         CHANGE(I,J)=DOTVAR(I,J)                                      MAIN172
  260 CONTINUE                                                        MAIN173
C*****************************************************************
C                                                                    *
C     CALCULATE WORLD VARIABLES                                      *
C                                                                    *
C*****************************************************************
      DO 300 I=1,4                                                    MAIN174
         WORDEM(I,IMINRL)=0.0                                         MAIN175
         IF (I.GE.3) GO TO 270                                        MAIN176
         WORSUP(I,IMINRL)=0.0                                         MAIN177
         WORSCP(I,IMINRL)=0.0                                         MAIN178
         WSSUM(I,IMINRL)=0.0                                          MAIN179
         IF (I.EQ.1) GO TO 300                                        MAIN180
  270    CONTINUE                                                     MAIN181
         DO 280 J=1,ICNTRY                                            MAIN182
            WORDEM(I,IMINRL)=WORDEM(I,IMINRL)+QDEM(I,J,IMINRL)        MAIN183
            IF (I.GE.3) GO TO 280                                     MAIN184
            WORSUP(I,IMINRL)=WORSUP(I,IMINRL)+QSUP(I,J,IMINRL)        MAIN185
            WORSCP(I,IMINRL)=WORSCP(I,IMINRL)+QSCP(I,J,IMINRL)        MAIN186
            WSSUM(I,IMINRL)=WSSUM(I,IMINRL)+QSPROD(I,J,IMINRL)        MAIN187
  280    CONTINUE                                                     MAIN188
         IF (I.GE.3) GO TO 300                                        MAIN189
         DO 290 J=1,ICNTRY                                            MAIN190
            ROWS(I,J,IMINRL)=WORSUP(I,IMINRL)-QSUP(I,J,IMINRL)        MAIN191
  290    CONTINUE                                                     MAIN192
  300 CONTINUE                                                        MAIN193
C*****************************************************************
C                                                                    *
C     CALCULATE CURRENT PERIOD EXOGENEOUS VARIABLES                  *
C                                                                    *
```

```
C*****************************************************************************
      PRICE(2,1,IMINRL)=PRICE(2,2,IMINRL)*PRCHA(IMINRL)                          MAIN194
      DO 320 J=1,4                                                               MAIN195
      DO 320 K=1,ICNTRY                                                          MAIN196
         IF (J.LE.2) GO TO 310                                                   MAIN197
         EXPARM(1,J,K)=CHANGE(J,K)                                               MAIN198
         GO TO 320                                                               MAIN199
  310    EXPARM(1,J,K)=EXPARM(2,J,K)*CHANGE(J,K)                                 MAIN200
  320 CONTINUE                                                                   MAIN201
C*****************************************************************************
C                                                                               *
C     NOW DO ITERATIONS TO SIMULATE FOR EACH YEAR                               *
C                                                                               *
C*****************************************************************************
      DO 500 ITER=1,IYRSIM                                                       MAIN202
         IF (IEXCHK.GE.IEXTRA) GO TO 350                                         MAIN203
         ICK=ITER+IYR-1                                                          MAIN204
C*****************************************************************************
C                                                                               *
C     CHECK IF NEW COUNTRY COMES ON LINE THIS YEAR. IF IT DOES                  *
C  ALTER EQUATION PARAMETERS.                                                   *
C                                                                               *
C*****************************************************************************
         DO 340 I=1,3                                                           MAIN205
            IF (INEW(I).NE.ICK) GO TO 330                                       MAIN206
            K=7+I                                                               MAIN207
            DMCOEF(10,K,IMINRL)=1.0+CNEW(I,2)                                   MAIN208
            SPCOEF(13,K,IMINRL)=1.0+CNEW(I,4)                                   MAIN209
            XX=CNEW(I,1)/DMCOEF(10,K,IMINRL)                                    MAIN210
            Y=CNEW(I,3)/SPCOEF(13,K,IMINRL)                                     MAIN211
            QDEM(2,K,IMINRL)=XX                                                 MAIN212
            QSUP(2,K,IMINRL)=Y                                                  MAIN213
            IEXCHK=IEXCHK+1                                                     MAIN214
  330       CONTINUE                                                            MAIN215
  340    CONTINUE                                                               MAIN216
  350    CONTINUE                                                               MAIN217
C*****************************************************************************
C                                                                               *
C     SET CURRENT VALUES TO ZERO                                                *
C                                                                               *
C*****************************************************************************
         DO 360 I=1,ICNTRY                                                      MAIN218
            QDEM(1,I,IMINRL)=0.0                                                MAIN219
            QSCP(1,I,IMINRL)=0.0                                                MAIN220
            QSUP(1,I,IMINRL)=0.0                                                MAIN221
  360    CONTINUE                                                               MAIN222
         WORDEM(1,IMINRL)=0.0                                                   MAIN223
         WORSUP(1,IMINRL)=0.0                                                   MAIN224
         WORSCP(1,IMINRL)=0.0                                                   MAIN225
         WSSUM(1,IMINRL)=0.0                                                    MAIN226
         PRICE(1,1,IMINRL)=0.0                                                  MAIN227
         YEAR=FLOAT(IYR+ITER-1)                                                 MAIN228
         WOREX=WORSUP(2,IMINRL)+WORSCP(2,IMINRL)-WORDEM(2,IMINRL)               MAIN229
C*****************************************************************************
C                                                                               *
C   CALCULATE PRICE                                                             *
C                                                                               *
C*****************************************************************************
         PRICE(1,1,IMINRL)=PRCADD(IPRICE,IMINRL,ITER,PRICE(1,2,IMINRL),         MAIN230
     1      PRICE(1,3,IMINRL),WOREX,WSSUM(2,IMINRL),YEAR,EXPARM(1,1,1),         MAIN231
```

```
     2      EXPARM(1,2,1),PRICE(2,1,IMINRL),PRICE(2,2,IMINRL),PRICE(2,3,   MAIN232
     3      IMINRL),0.0,0.0,0.0,0.0)                                       MAIN233
C*****************************************************************************
C                                                                            *
C     CALCULATE QUANTITY DEMANDED                                            *
C                                                                            *
C*****************************************************************************
          PDIF=PRICE(1,1,IMINRL)-PRICE(2,1,IMINRL)                          MAIN234
          PDIF1=PRICE(1,2,IMINRL)-PRICE(2,2,IMINRL)                         MAIN235
          PDIF2=PRICE(1,3,IMINRL)-PRICE(2,3,IMINRL)                         MAIN236
          WOREX2=WORSUP(2,IMINRL)-WORDEM(2,IMINRL)                          MAIN237
          DO 370 J=1,ICNTRY                                                 MAIN238
             QDEM(1,J,IMINRL)=GENADD(IQDEM,J,IMINRL,1,ITER,PDIF,PDIF1,      MAIN239
     1         PDIF2,WOREX2,EXPARM(1,1,J),EXPARM(2,1,J),EXPARM(2,3,J),      MAIN240
     2         EXPARM(2,4,J),QDEM(2,J,IMINRL),0.0,0.0,0.0,0.0,0.0,0.0)      MAIN241
             WORDEM(1,IMINRL)=WORDEM(1,IMINRL)+QDEM(1,J,IMINRL)             MAIN242
  370     CONTINUE                                                          MAIN243
C*****************************************************************************
C                                                                            *
C     CALCULATE SCRAP                                                        *
C                                                                            *
C*****************************************************************************
          DO 380 J=1,ICNTRY                                                 MAIN244
             QSCP(1,J,IMINRL)=GENADD(IQSCP,J,IMINRL,2,ITER,PRICE(1,1,       MAIN245
     1         IMINRL),PRICE(1,2,IMINRL),PRICE(1,3,IMINRL),QDEM(1,J,        MAIN246
     2         IMINRL),QDEM(2,J,IMINRL),QDEM(3,J,IMINRL),QDEM(4,J,          MAIN247
     3         IMINRL),QSCP(2,J,IMINRL),WORDEM(1,IMINRL),WORDEM(2,          MAIN248
     4         IMINRL),WORDEM(3,IMINRL),WORDEM(4,IMINRL),0.0,0.0)           MAIN249
             WORSCP(1,IMINRL)=WORSCP(1,IMINRL)+QSCP(1,J,IMINRL)             MAIN250
  380     CONTINUE                                                          MAIN251
C*****************************************************************************
C                                                                            *
C     CALCULATE SUPPLY\                                                      *
C                                                                            *
C*****************************************************************************
          DO 390 J=1,ICNTRY                                                 MAIN252
             QSUP(1,J,IMINRL)=GENADD(IQSUP,J,IMINRL,3,ITER,PRICE(1,1,       MAIN253
     1         IMINRL),PRICE(1,2,IMINRL),PRICE(1,3,IMINRL),ROWS(2,J,        MAIN254
     2         IMINRL),WORDEM(1,IMINRL),WORDEM(2,IMINRL),WORDEM(3,          MAIN255
     3         IMINRL),YEAR,EXPARM(1,2,J),EXPARM(2,2,J),QSPROD(2,J,         MAIN256
     4         IMINRL),QSUP(2,J,IMINRL),0.0,0.0)                            MAIN257
             QSPROD(1,J,IMINRL)=QSPROD(2,J,IMINRL)+QSUP(2,J,IMINRL)         MAIN258
             WSSUM(1,IMINRL)=WSSUM(1,IMINRL)+QSPROD(1,J,IMINRL)             MAIN259
             WORSUP(1,IMINRL)=WORSUP(1,IMINRL)+QSUP(1,J,IMINRL)             MAIN260
                                                                            MAIN261
  390     CONTINUE                                                          MAIN262
          DO 400 I=1,ICNTRY                                                 MAIN263
             ROWS(1,I,IMINRL)=WORSUP(1,IMINRL)-QSUP(1,I,IMINRL)             MAIN264
  400     CONTINUE                                                          
C*****************************************************************************
C                                                                            *
C UPDATE OUTPUT ARRAY NEXT AND THEN UPDATE VARIABLE FOR NEXT ITERATION       *
C                                                                            *
C*****************************************************************************
          YEAR=YEAR+1900.0                                                  MAIN265
          DO 410 J=1,ICNTRY                                                 MAIN266
             OUTPUT(1,J,ITER)=QSUP(1,J,IMINRL)                              MAIN267
             OUTPUT(2,J,ITER)=QSCP(1,J,IMINRL)                              MAIN268
             OUTPUT(3,J,ITER)=QDEM(1,J,IMINRL)                              MAIN269
             OUTPUT(4,J,ITER)=PRICE(1,1,IMINRL)                             MAIN270
  410     CONTINUE                                                          MAIN271
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      OUTPUT(1,IWORLD,ITER)=WGRSUP(1,IMINRL)                            MAIN272
      OUTPUT(2,IWORLD,ITER)=WGRSCP(1,IMINRL)                            MAIN273
      OUTPUT(3,IWORLD,ITER)=WGRDEM(1,IMINRL)                            MAIN274
      OUTPUT(4,IWORLD,ITER)=PRICE(1,1,IMINRL)                           MAIN275
      IF (IEXCHK.GT.IEXTRA) GO TO 430                                   MAIN276
      ICK=ITER+IYR-1                                                    MAIN277
      DO 420 I=1,3                                                      MAIN278
         IF (INEW(I).NE.ICK) GO TO 420                                  MAIN279
         K=7+I                                                          MAIN280
         QDEM(2,K,IMINRL)=0.0                                           MAIN281
         QSUP(2,K,IMINRL)=0.0                                           MAIN282
  420 CONTINUE                                                          MAIN283
  430 CONTINUE                                                          MAIN284
      DO 480 I=1,3                                                      MAIN285
         K=5-I                                                          MAIN286
         L=K-1                                                          MAIN287
         DO 460 J=1,ICNTRY                                              MAIN288
            IF (I.EQ.1) GO TO 450                                       MAIN289
            IF (I.EQ.2) GO TO 440                                       MAIN290
            QSUP(K,J,IMINRL)=QSUP(L,J,IMINRL)                           MAIN291
            QSCP(K,J,IMINRL)=QSCP(L,J,IMINRL)                           MAIN292
            QSPROD(K,J,IMINRL)=QSPROD(L,J,IMINRL)                       MAIN293
  440       ROWS(K,J,IMINRL)=ROWS(L,J,IMINRL)                           MAIN294
  450       QDEM(K,J,IMINRL)=QDEM(L,J,IMINRL)                           MAIN295
  460    CONTINUE                                                       MAIN296
         WORDEM(K,IMINRL)=WORDEM(L,IMINRL)                              MAIN297
         IF (I.EQ.1) GO TO 480                                          MAIN298
         IF (I.EQ.2) GO TO 470                                          MAIN299
         WGRSUP(K,IMINRL)=WORSUP(L,IMINRL)                              MAIN300
         WGRSCP(K,IMINRL)=WORSCP(L,IMINRL)                              MAIN301
  470    WSSUM(K,IMINRL)=WSSUM(L,IMINRL)                                MAIN302
         PRICE(1,K,IMINRL)=PRICE(1,L,IMINRL)                            MAIN303
         PRICE(2,K,IMINRL)=PRICE(2,L,IMINRL)                            MAIN304
  480 CONTINUE                                                          MAIN305
      DO 490 J=1,4                                                      MAIN306
      DO 490 I=1,ICNTRY                                                 MAIN307
         EXPARM(2,J,I)=EXPARM(1,J,I)                                    MAIN308
         IF (J.GE.3) GO TO 490                                          MAIN309
         EXPARM(1,J,I)=EXPARM(2,J,I)*CHANGE(J,I)                        MAIN310
  490 CONTINUE                                                          MAIN311
      PRICE(2,1,IMINRL)=PRICE(2,1,IMINRL)*PRCHA(IMINRL)                 MAIN312
  500 CONTINUE                                                          MAIN313
C*************************************************************************
C                                                                       *
C     CONVERT TO CURRENT DOLLARS AS SET BY WPI.                         *
C     PROGRAM PRESENTLY USING 1979 DOLLARS.                             *
C     TO CHANGE MODIFY VARIABLE, WPI, IN DATA BLOCK.                    *
C                                                                       *
C NOTE: ALL CALCULATIONS ARE DONE IN TERMS OF 1970 DOLLARS.             *
C                                                                       *
C*************************************************************************
      DO 510 I=1,IWORLD                                                 MAIN314
      DO 510 J=1,IYRSIM                                                 MAIN315
         OUTPUT(4,I,J)=OUTPUT(4,I,J)*WPI                                MAIN316
  510 CONTINUE                                                          MAIN317
C*************************************************************************
C                                                                       *
C     WHEN DONE ITERATING PRINT AND PLOT ACCORDING TO OPTIONS           *
C                                                                       *
C*************************************************************************
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      IF (IPRTCT.EQ.1) GO TO 530                                          MAIN318
      CALL CRTPRT (IMINRL,IGROW,ISHIFT)                                   MAIN319
      IF (IPLOT.EQ.0.AND.IPRTCT.NE.0) GO TO 530                           MAIN320
      IF (IPRTCT.EQ.0) GO TO 560                                          MAIN321
      IF (IPLTPR.EQ.1) CALL PLOT (IMINRL,4,IYRSIM,IYRPLT,0,IWORLD)        MAIN322
      DO 520 I=1,3                                                        MAIN323
      DO 520 J=1,IWORLD                                                   MAIN324
         IF (IPLTVR(I,J).EQ.1) CALL PLOT (IMINRL,I,IYRSIM,IYRPLT,0,J)     MAIN325
  520 CONTINUE                                                            MAIN326
      IF (IPRTCT.EQ.0) GO TO 560                                          MAIN327
  530 CONTINUE                                                            MAIN328
      CALL LINPRT (IMINRL,IGROW,ISHIFT)                                   MAIN329
      IF (IPLOT.EQ.0) GO TO 560                                           MAIN330
      IF (IPLTPR.EQ.1) CALL PLOT (IMINRL,4,IYRSIM,IYRPLT,1,IWORLD)        MAIN331
      DO 540 I=1,3                                                        MAIN332
      DO 540 J=1,IWORLD                                                   MAIN333
         IF (IPLTVR(I,J).EQ.1) CALL PLOT (IMINRL,I,IYRSIM,IYRPLT,1,J)     MAIN334
  540 CONTINUE                                                            MAIN335
      GO TO 560                                                           MAIN336
  550 CONTINUE                                                            MAIN337
C*************************************************************************
C                                                                        *
C     COME HERE IF ERROR ON INPUT OF USER OPTIONS                        *
C                                                                        *
C*************************************************************************
      IF (IERROR(1).NE.0) WRITE (6,1120) IMINRL                           MAIN338
      IF (IERROR(2).NE.0) WRITE (6,1130) IPRTCT                           MAIN339
      IF (IERROR(3).NE.0) WRITE (6,1140) IMINRL                           MAIN340
      IF (IERROR(4).NE.0) WRITE (6,1150) IGROW                            MAIN341
      IF (IERROR(5).NE.0) WRITE (6,1160) ISHIFT                           MAIN342
      IF (IERROR(6).NE.0) WRITE (6,1170) IEXTRA                           MAIN343
      IF (IERROR(7).NE.0) WRITE (6,1180) IYRFST,IYRSIM                    MAIN344
      IF (IERROR(8).NE.0) WRITE (6,1190) IPLOT                            MAIN345
      IF (IERROR(9).NE.0) WRITE (6,1200) ICNT(IERROR(9)),ICNTRY           MAIN346
      IF (IERROR(10).NE.0) WRITE (6,1210) ICNT(IERROR(10)),               MAIN347
     1  IGRT(IERROR(10))                                                  MAIN348
      IF (IERROR(11).NE.0) WRITE (6,1220) IGRT(IERROR(11))                MAIN349
      IF (IERROR(12).NE.0) WRITE (6,1230) IERROR(12),IYR,IYRMAX           MAIN350
  560 CONTINUE                                                            MAIN351
      STOP                                                                MAIN352
 1000 FORMAT (2I1,5I2,I1)                                                 MAIN353
 1010 FORMAT (I1,I2)                                                      MAIN354
 1020 FORMAT (2I1,2PF14.6)                                                MAIN355
 1030 FORMAT (I1,I2,2(0PF10.4,2PF10.4,4A4))                               MAIN356
 1040 FORMAT (2I2,I1,I2,2PF10.4)                                          MAIN357
 1050 FORMAT (1H1,20X,19H LIST OF DATA CARDS)                             MAIN358
 1060 FORMAT (4X,87H RULE  1234567810_234567820_234567830_234567840_2345 MAIN359
     1e7850_234567860_234567870_234567880)                                MAIN360
 1070 FORMAT (11X,I1,I2)                                                  MAIN361
 1080 FORMAT (11X,2I1,5I2,I1)                                             MAIN362
 1090 FORMAT (11X,2I1,2PF14.6)                                            MAIN363
 1100 FORMAT (11X,I1,I2,2(0PF10.4,2PF10.4,4A4))                           MAIN364
 1110 FORMAT (11X,2I2,I1,I2,2PF10.4)                                      MAIN365
 1120 FORMAT (2X,15H ERROR--IMINRL=,I2,29H ALLOWABLE VALUES MIN=1 MAX=5)  MAIN366
 1130 FORMAT (2X,15H ERROR--IPRTCT=,I2,29H ALLOWABLE VALUES MIN=1 MAX=3)  MAIN367
 1140 FORMAT (2X,15H ERROR--IYRSIM=,I2,30H ALLOWABLE VALUES MIN=1 MAX=99  MAIN368
     1)                                                                   MAIN369
 1150 FORMAT (2X,15H ERROR--IGROW =,I2,30H ALLOWABLE VALUES MIN=1 MAX=99  MAIN370
     1)                                                                   MAIN371
 1160 FORMAT (2X,15H ERROR--ISHIFT=,I2,30H ALLOWABLE VALUES MIN=1 MAX=99  MAIN372
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```
     1)                                                                 MAIN373
 1170 FORMAT (2X,15H ERROR--IEXTRA=,I2,29H ALLOWABLE VALUES MIN=1 MAX=3) MAIN374
 1180 FORMAT (2X,27H ERROR--INITIAL YEAR INDEX=,I2,                     MAIN375
     1  28H ALLOWABLE VALUES MIN=0 MAX=,I2)                            MAIN376
 1190 FORMAT (2X,15H ERROR-- IPLOT=,I2,30H ALLOWABLE VALUES MIN=0 MAX=99 MAIN377
     1)                                                                 MAIN378
 1200 FORMAT (2X,28H ERROR--COUNTRY GROUP INDEX=,I2,                    MAIN379
     1  28H ALLOWABLE VALUES MIN=0 MAX=,I2)                            MAIN380
 1210 FORMAT (2X,28H ERROR--COUNTRY GROUP INDEX=,I2,                    MAIN381
     1  17H SPECIFYING WORLD,/10X,22HBUT GROWTH RATE INDEX=,I2,        MAIN382
     2  3CH WHICH DOES NOT SPECIFY PRICE.)                             MAIN383
 1220 FORMAT (2X,26H ERROR--GROWTH RATE INDEX=,I2,29H ALLOWABLE VALUES M MAIN384
     1IN=1 MAX=5)                                                       MAIN385
 1230 FORMAT (2X,43H ERROR--INITIAL YEAR INDEX FOR GROWTH RATE=,I2,/,   MAIN386
     1  22H ALLOWABLE VALUES MIN=,I2,5H MAX=,I2)                       MAIN387
 1231 FORMAT ('1')
 1232 FORMAT (T20,48HTHE MODIFIED NICKEL MODEL IS NO LONGER RELEVANT.)
 1233 FORMAT (T20,42HUSE THE NORMAL NICKEL MODEL (IMINRL = 3 ).)
 1234 FORMAT (T20,45HFOR MORE COMPLETE INFORMATION, SEE THE REPORT)
 1235 FORMAT (T20,32HON THE UPDATE OF THE OMNR MODEL.)
      END                                                               MAIN388
C*************************************************************************
C                                                                       *
C     CRT PRINT SUBROUTINE ----CALLED BY MAIN PROGRAM                   *
C                                                                       *
C*************************************************************************
      SUBROUTINE CRTPRT(IMINRL,IGROW,ISHIFT)                            CRT001
      COMMON / AREANM / NAME (2,4), NAMSUB (2,4), NAMCNT (4,11),        CRT002
     1  NAMEXT(2,5),NAMVAR(2,4), IYRSFT(20), SHIFT(20), ICTSHT(20),     CRT003
     2  IVETLB(22,4),ISTAR,IBLANK,IHATCH,IBAR,IPLTVR(3,12),IPLTPR       CRT004
      COMMON / AREOUT / OUTPUT (4,11,25), DOTVAR (4,10), PRDOT (4),     CRT005
     1 ICNT(25), IGRT(25), USRGRT(25), GROW(25)                         CRT006
      COMMON / AREPRM / ICNTRY,IYR,IPRICE,IQDEM,IQSUP,IQSCP,IYRSIM,     CRT007
     1 IYRFST, NIKCHK,  IWORLD, IANN, IEXCHK, INEW(3), IERROR(14),IPG,  CRT008
     2 ISVAR(20), ISLEN(20), KVAR(3), IEXTRA, CNEW(3,4), ISCALE(30)     CRT009
C*************************************************************************
C                                                                       *
C WRITE HEADER AND EXOGENOUS DATA                                       *
C                                                                       *
C*************************************************************************
      WRITE (6,5310)                                                    CRT010
      WRITE (6,5300)                                                    CRT011
      WRITE (6,5070) NAME(1,IMINRL),NAME(2,IMINRL)                      CRT012
      WRITE (6,5300)                                                    CRT013
      IF (NIKCHK.EQ.1) WRITE (6,5350)                                   CRT014
      IF (NIKCHK.EQ.1) WRITE (6,5300)                                   CRT015
      WRITE (6,5080)                                                    CRT016
      WRITE (6,5300)                                                    CRT017
      WRITE (6,509C)                                                    CRT018
      WRITE (6,5100)                                                    CRT019
      WRITE (6,5110)                                                    CRT020
      WRITE (6,5120)                                                    CRT021
      WRITE (6,5130)                                                    CRT022
      DO 5010 I=1,ICNTRY                                                CRT023
         WRITE (6,5140) (NAMCNT(J,I),J=1,4),DOTVAR(1,I),DOTVAR(2,I),    CRT024
     1      DOTVAR(4,I),DOTVAR(3,I)                                     CRT025
 5010 CONTINUE                                                          CRT026
      WRITE (6,5300)                                                    CRT027
      WRITE (6,5150) NAMSUB(1,IMINRL),NAMSUB(2,IMINRL)                  CRT028
      WRITE (6,5300)                                                    CRT029
```

```
      WRITE (6,5160) PROOT(IMINRL)                                          CRT030
      IF (IGROW.EQ.0) GO TO 5030                                            CRT031
C*****************************************************************************
C                                                                            *
C     WRITE ALTERED GROWTH RATES HERE.                                       *
C                                                                            *
C*****************************************************************************
      WRITE (6,5300)                                                        CRT032
      WRITE (6,5210)                                                        CRT033
      WRITE (6,5300)                                                        CRT034
      WRITE (6,5220)                                                        CRT035
      WRITE (6,5230)                                                        CRT036
      DO 5020 I=1,IGROW                                                     CRT037
         K=ICNT(I)                                                          CRT038
         L=IGRT(I)                                                          CRT039
         IF (K.EQ.0) K=IWORLD                                               CRT040
         IF (L.EQ.4) USRGRT(I)=USRGRT(I)/100.0                              CRT041
         WRITE (6,5240) (NAMCNT(J,K),J=1,4),(NAMEXT(M,L),M=1,2),            CRT042
     1      USRGRT(I)                                                       CRT043
 5020 CONTINUE                                                              CRT044
 5030 CONTINUE                                                              CRT045
      IF (ISHIFT.EQ.0) GO TO 5050                                           CRT046
C*****************************************************************************
C                                                                            *
C     WRITE EXOGENEOUS SHIFTS HERE                                           *
C                                                                            *
C*****************************************************************************
      WRITE (6,5300)                                                        CRT047
      WRITE (6,5250)                                                        CRT048
      WRITE (6,5300)                                                        CRT049
      WRITE (6,5260)                                                        CRT050
      WRITE (6,5270)                                                        CRT051
      WRITE (6,5280)                                                        CRT052
      DO 5040 I=1,ISHIFT                                                    CRT053
         IYRSTP=IYRSFT(I)+ISLEN(I)                                          CRT054
         K=ISVAR(I)                                                         CRT055
         IF (K.EQ.0) K=4                                                    CRT056
         L=ICTSHT(I)                                                        CRT057
         WRITE (6,5290) (NAMCNT(J,L),J=1,4),(NAMVAR(M,K),M=1,2),            CRT058
     1      SHIFT(I),IYRSFT(I),IYRSTP                                       CRT059
 5040 CONTINUE                                                              CRT060
 5050 CONTINUE                                                              CRT061
C*****************************************************************************
C                                                                            *
C     WRITE WORLD VARIABLES HERE                                             *
C                                                                            *
C*****************************************************************************
      DO 5060 I=1,IWORLD                                                    CRT063
         WRITE (6,5300)                                                     CRT064
         WRITE (6,5300)                                                     CRT065
         WRITE (6,5170) (NAMCNT(J,I),J=1,4)                                 CRT066
         IF (IMINRL.LE.2.OR.I.EQ.IWORLD) WRITE (6,5180)                     CRT067
         IF (IMINRL.LE.2.OR.I.EQ.IWORLD) WRITE (6,5190)                     CRT068
         IF (IMINRL.GE.3.AND.I.NE.IWORLD) WRITE (6,5320)                    CRT069
         IF (IMINRL.GE.3.AND.I.NE.IWORLD) WRITE (6,5330)                    CRT070
      DO 5060 K=IYRFST,IYRSIM                                               CRT071
         IYEAR=IANN+K                                                       CRT072
         IF (IMINRL.LE.2.OR.I.EQ.IWORLD) WRITE (6,5200) IYEAR,(OUTPUT(J,    CRT073
     1      I,K),J=1,4)                                                     CRT074
         IF (IMINRL.GE.3.AND.I.NE.IWORLD) WRITE (6,5340) IYEAR,OUTPUT(1,    CRT075
```

```
     1     I,K),OUTPUT(3,I,K),OUTPUT(4,I,K)                                  CRT076
 5060 CONTINUE                                                               CRT077
      RETURN                                                                 CRT078
 5070 FORMAT (28X,24A4)                                                      CRT079
 5080 FORMAT (27X,11HASSUMPTIONS)                                            CRT080
 5090 FORMAT (25X,15HRATES OF CHANGE)                                        CRT081
 5100 FORMAT (40X,5HMONEY)                                                   CRT082
 5110 FORMAT (27X,30HINTEREST     GROWTH      CAPITAL)                       CRT083
 5120 FORMAT (18X,41HINCOME      RATE        RATE     ACQUISITION)           CRT084
 5130 FORMAT (17X,42H--------  --------    --------  -----------)            CRT085
 5140 FORMAT (1X,4A4,1X,2PF6.2,4X,F6.2,4X,0PF6.2,6X,2PF6.2)                  CRT086
 5150 FORMAT (17X,20HSUBSTITUTE METAL -- ,2A4)                               CRT087
 5160 FORMAT (17X,23HRATE OF PRICE CHANGE    ,2PF6.2)                       CRT088
 5170 FORMAT (24X,4A4)                                                       CRT089
 5180 FORMAT (1H ,8X,44HYEAR     SUPPLY      SCRAP     DEMAND      PRICE)    CRT090
 5190 FORMAT (9X,44H----     ------      -----     ------      -----)        CRT091
 5200 FORMAT (9X,I4,3(2X,F8.1),2X,F8.3)                                      CRT092
 5210 FORMAT (1H0,9X,45HTHE FOLLOWING GROWTH RATES HAVE BEEN ALTERED.)       CRT093
 5220 FORMAT (15X,35HCOUNTRY GROUP          VARIABLE  RATE)                  CRT094
 5230 FORMAT (15X,35H-------------          --------  ----)                  CRT095
 5240 FORMAT (14X,4A4,6X,2A4,1X,2PF5.1)                                      CRT096
 5250 FORMAT (1H0,4X,52HTHE FOLLOWING EXTERNAL SHOCK EFFECTS HAVE BEEN U     CRT097
     1SED.)                                                                  CRT098
 5260 FORMAT (32X,37HPERCENTAGE                INITIAL  FINAL)               CRT099
 5270 FORMAT (5X,53HCOUNTRY GROUP     EQUATION      SHIFT       YEAR     YEA CRT100
     1R)                                                                     CRT101
 5280 FORMAT (5X,53H-------------     --------      -----       ----     --- CRT102
     1-)                                                                     CRT103
 5290 FORMAT (4X,4A4,2X,2A4,2X,2PF8.2,7X,I2,6X,I2)                           CRT104
 5300 FORMAT (1H )                                                           CRT105
 5310 FORMAT (1H1)                                                           CRT106
 5320 FORMAT (1H-,13X,35HYEAR     SUPPLY      DEMAND      PRICE)             CRT107
 5330 FORMAT (14X,35H----     ------      ------      -----)                 CRT108
 5340 FORMAT (14X,I4,2X,F8.1,3X,F8.1,2X,F8.3)                                CRT109
 5350 FORMAT (26X,13HMODIFIED CASE)                                          CRT110
      END                                                                    CRT111
C*************************************************************************
C                                                                        *
C     LINE PRINTER PRINT SUBROUTINE ----CALLED BY MAIN PROGRAM           *
C                                                                        *
C*************************************************************************
      SUBROUTINE LINPRT(IMINRL,IGROW,ISHIFT)                             LPRT001
      COMMON / AREANM / NAME (2,4), NAMSUB (2,4), NAMCNT (4,11),         LPRT002
     1  NAMEXT(2,5),NAMVAR(2,4), IYRSFT(20), SHIFT(20), ICTSHT(20),      LPRT003
     2  IVETLB(22,4),ISTAR,IBLANK,IHATCH,IBAR,IPLTVR(3,12),IPLTPR        LPRT004
      COMMON / AREOUT / OUTPUT (4,11,25), DOTVAR (4,10), PRDOT (4),      LPRT005
     1 ICNT(25), IGRT(25), USRGRT(25), GROW(25)                          LPRT006
      COMMON / AREPRM / ICNTRY,IYR,IPRICE,IQDEM,IQSUP,IQSCP,IYRSIM,      LPRT007
     1 IYRFST, NIKCHK,  IWORLD, IANN, IEXCHK, INEW(3), IERROR(14),IPG,   LPRT008
     2 ISVAR(20), ISLEN(20), KVAR(3), IEXTRA, CNEW(3,4), ISCALE(30)      LPRT009
C*************************************************************************
C                                                                        *
C     WRITE HEADER INFO AND EXOGENEOUS DATA                              *
C                                                                        *
C*************************************************************************
      IPRNT=ICNTRY-1                                                     LPRT010
      WRITE (6,5380)                                                     LPRT011
      WRITE (6,5370)                                                     LPRT012
      WRITE (6,5140) NAME(1,IMINRL),NAME(2,IMINRL)                       LPRT013
      WRITE (6,5370)                                                     LPRT014
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      IF (NIKCHK.EQ.1) WRITE (6,5420)                                    LPRT015
      IF (NIKCHK.EQ.1) WRITE (6,5370)                                    LPRT016
      WRITE (6,5150)                                                     LPRT017
      WRITE (6,5370)                                                     LPRT018
      WRITE (6,5160)                                                     LPRT019
      WRITE (6,5170)                                                     LPRT020
      WRITE (6,5180)                                                     LPRT021
      WRITE (6,5190)                                                     LPRT022
      WRITE (6,5200)                                                     LPRT023
      DO 5010 I=1,ICNTRY                                                 LPRT024
         WRITE (6,5210) (NAMCNT(J,I),J=1,4),DOTVAR(1,I),DOTVAR(2,I),     LPRT025
     1     DOTVAR(4,I),DOTVAR(3,I)                                       LPRT026
 5010 CONTINUE                                                          LPRT027
      WRITE (6,5370)                                                     LPRT028
      WRITE (6,5220) NAMSUB(1,IMINRL),NAMSUB(2,IMINRL)                   LPRT029
      WRITE (6,5370)                                                     LPRT030
      WRITE (6,5230) PRCOT(IMINRL)                                       LPRT031
      IF (IGROW.EQ.0) GO TO 5030                                         LPRT032
C*********************************************************************
C                                                                     *
C     WRITE ALTERED GROWTH RATES                                      *
C                                                                     *
C*********************************************************************
      WRITE (6,5370)                                                     LPRT033
      WRITE (6,5280)                                                     LPRT034
      WRITE (6,5370)                                                     LPRT035
      WRITE (6,5290)                                                     LPRT036
      WRITE (6,5300)                                                     LPRT037
      DO 5020 I=1,IGROW                                                  LPRT038
         K=ICNT(I)                                                       LPRT039
         L=IGRT(I)                                                       LPRT040
         IF (K.EQ.0) K=IWORLD                                            LPRT041
         IF (L.EQ.4) USRGRT(I)=USRGRT(I)/100.0                           LPRT042
         WRITE (6,5310) (NAMCNT(J,K),J=1,4),(NAMEXT(M,L),M=1,2),         LPRT043
     1     USRGRT(I)                                                     LPRT044
 5020 CONTINUE                                                          LPRT045
 5030 CONTINUE                                                          LPRT046
      IF (ISHIFT.EQ.0) GO TO 5050                                        LPRT047
C*********************************************************************
C                                                                     *
C     WRITE EXOGENEOUS SHIFTS                                         *
C                                                                     *
C*********************************************************************
      WRITE (6,5370)                                                     LPRT048
      WRITE (6,5320)                                                     LPRT049
      WRITE (6,5370)                                                     LPRT050
      WRITE (6,5330)                                                     LPRT051
      WRITE (6,5340)                                                     LPRT052
      WRITE (6,5350)                                                     LPRT053
      DO 5040 I=1,ISHIFT                                                 LPRT054
         IYRSTP=IYRSFT(I)+ISLEN(I)                                       LPRT055
         K=ISVAR(I)                                                      LPRT056
         IF (K.EQ.0) K=4                                                 LPRT057
         L=ICTSHT(I)                                                     LPRT058
         WRITE (6,5360) (NAMCNT(J,L),J=1,4),(NAMVAR(M,K),M=1,2),         LPRT059
     1     SHIFT(I),IYRSFT(I),IYRSTP                                     LPRT060
 5040 CONTINUE                                                          LPRT061
 5050 CONTINUE                                                          LPRT062
      IF (IEXTRA.EQ.0) GO TO 5090                                        LPRT063
C*********************************************************************
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C
C      IF EXTRA COUNTRY, WRITE INDIVIDUAL COUNTRY DATA                          *
C                                                                               *
C*******************************************************************************
      L=ICNTRY/2
      LL=ICNTRY-(L*2)                                                          LPRT064
      DO 5080 K=1,L                                                            LPRT065
         KK=((K-1)*2)+1                                                        LPRT066
         LLL=MOD(K,2)                                                          LPRT067
         IF (LLL.EQ.1) WRITE (6,5380)                                          LPRT068
         WRITE (6,5370)                                                        LPRT069
         WRITE (6,5430) (NAMCNT(J,KK),J=1,4),(NAMCNT(J,KK+1),J=1,4)            LPRT070
         IF (IMINRL.LE.2) WRITE (6,5440)                                       LPRT071
         IF (IMINRL.LE.2) WRITE (6,5450)                                       LPRT072
         IF (IMINRL.GE.3) WRITE (6,5470)                                       LPRT073
         IF (IMINRL.GE.3) WRITE (6,5480)                                       LPRT074
         DO 5060 M=IYRFST,IYRSIM                                               LPRT075
            IYEAR=IANN+M                                                       LPRT076
            IF (IMINRL.LE.2) WRITE (6,5460) IYEAR,(OUTPUT(J,KK,M),J=1,         LPRT077
     1        4),IYEAR,(OUTPUT(J,KK+1,M),J=1,4)                                LPRT078
            IF (IMINRL.GE.3) WRITE (6,5490) IYEAR,OUTPUT(1,KK,M),OUTPUT        LPRT079
     1        (3,KK,M),OUTPUT(4,KK,M),IYEAR,OUTPUT(1,KK+1,M),                  LPRT080
     1        OUTPUT(3,KK+1,M),OUTPUT(4,KK+1,M)                                LPRT081
 5060    CONTINUE                                                              LPRT082
         IF ((K.NE.L).OR.(LL.EQ.0)) GO TO 5080                                 LPRT083
         WRITE (6,5370)                                                        LPRT084
         WRITE (6,5240) (NAMCNT(J,ICNTRY),J=1,4)                               LPRT085
         WRITE (6,5370)                                                        LPRT086
         IF (IMINRL.LE.2) WRITE (6,5250)                                       LPRT087
         IF (IMINRL.LE.2) WRITE (6,5260)                                       LPRT088
         IF (IMINRL.GE.3) WRITE (6,5390)                                       LPRT089
         IF (IMINRL.GE.3) WRITE (6,5400)                                       LPRT090
         DO 5070 M=IYRFST,IYRSIM                                               LPRT091
            IYEAR=IANN+M                                                       LPRT092
            IF (IMINRL.LE.2) WRITE (6,5270) IYEAR,(OUTPUT(J,ICNTRY,M),         LPRT093
     1        J=1,4)                                                           LPRT094
            IF (IMINRL.GE.2) WRITE (6,5410) IYEAR,(OUTPUT(J,ICNTRY,M),         LPRT095
     1        J=1,4)                                                           LPRT096
 5070    CONTINUE                                                              LPRT097
 5080 CONTINUE                                                                 LPRT098
      GO TO 5120                                                               LPRT099
 5090 CONTINUE                                                                 LPRT100
C*******************************************************************************LPRT101
C                                                                               *
C      IF NO EXTRA COUNTRIES, WRITE INDIVIDUAL COUNTRY DATA                     *
C                                                                               *
C*******************************************************************************
      IF (IPG.GT.10) WRITE (6,5380)
      WRITE (6,5500)                                                           LPRT102
      WRITE (6,5510)                                                           LPRT103
      WRITE (6,5520)                                                           LPRT104
      DO 5100 K=IYRFST,IYRSIM                                                  LPRT105
         IYEAR=IANN+K                                                          LPRT106
         WRITE (6,5530) IYEAR,(OUTPUT(1,J,K),OUTPUT(3,J,K),J=1,ICNTRY)         LPRT107
 5100 CONTINUE                                                                 LPRT108
      IF (IMINRL.GE.3) GO TO 5120                                              LPRT109
      IF (IPG.NE.0.AND.IPG.LE.10) WRITE (6,5380)                               LPRT110
      WRITE (6,5580)                                                           LPRT111
      WRITE (6,5590)                                                           LPRT112
      WRITE (6,5600)                                                           LPRT113
                                                                               LPRT114
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      WRITE (6,5610)                                                    LPRT115
      DO 5110 K=IYRFST,IYRSIM                                           LPRT116
         IYEAR=IANN+K                                                   LPRT117
         WRITE (6,5620) IYEAR,(OUTPUT(2,J,K),J=1,IPRNT)                 LPRT118
 5110 CONTINUE                                                          LPRT119
 5120 CONTINUE                                                          LPRT120
C*************************************************************************
C                                                                       *
C     WRITE WORLD DATA HERE                                             *
C                                                                       *
C*************************************************************************
      IF ((IPG.EQ.0.AND.IMINRL.LE.2).OR.(IEXTRA.NE.0)) WRITE (6,5380)   LPRT121
      WRITE (6,5540)                                                    LPRT122
      WRITE (6,5550)                                                    LPRT123
      WRITE (6,5560)                                                    LPRT124
      DO 5130 K=IYRFST,IYRSIM                                           LPRT125
         IYEAR=IANN+K                                                   LPRT126
         WRITE (6,5570) IYEAR,(OUTPUT(J,IWORLD,K),J=1,4)                LPRT127
 5130 CONTINUE                                                          LPRT128
      RETURN                                                            LPRT129
 5140 FORMAT (60X,2A4)                                                  LPRT130
 5150 FORMAT (59X,11HASSUMPTIONS)                                       LPRT131
 5160 FORMAT (57X,15HRATES OF CHANGE)                                   LPRT132
 5170 FORMAT (72X,5HMONEY)                                              LPRT133
 5180 FORMAT (59X,30HINTEREST    GROWTH      CAPITAL)                   LPRT134
 5190 FORMAT (50X,41HINCOME      RATE        RATE    ACQUISITION)       LPRT135
 5200 FORMAT (1H+,48X,42H________  ________    ________  ___________)    LPRT136
 5210 FORMAT (33X,4A4,1X,2PF6.2,4X,F6.2,4X,0PF6.2,6X,2PF6.2)            LPRT137
 5220 FORMAT (49X,20HSUBSTITUTE METAL -- ,2A4)                          LPRT138
 5230 FORMAT (49X,23HRATE OF PRICE CHANGE   ,2PF6.2)                    LPRT139
 5240 FORMAT (57X,4A4)                                                  LPRT140
 5250 FORMAT (1H-,42X,44HYEAR    SUPPLY      SCRAP    DEMAND      PRICE)  LPRT141
 5260 FORMAT (43X,44H____    ______      _____    ______      _____)    LPRT142
 5270 FORMAT (43X,I4,3(2X,F8.1),2X,F8.3)                                LPRT143
 5280 FORMAT (1H0,41X,45HTHE FOLLOWING GROWTH RATES HAVE BEEN ALTERED.)  LPRT144
 5290 FORMAT (47X,35HCOUNTRY GROUP         VARIABLE  RATE)              LPRT145
 5300 FORMAT (1H+,46X,35H_____________         ________  ____)          LPRT146
 5310 FORMAT (46X,4A4,6X,2A4,1X,2PF5.1)                                 LPRT147
 5320 FORMAT (1H0,36X,52HTHE FOLLOWING EXTERNAL SHOCK EFFECTS HAVE BEEN  LPRT148
     1USED.)                                                            LPRT149
 5330 FORMAT (53X,37HPERCENTAGE              INITIAL  FINAL)            LPRT150
 5340 FORMAT (37X,53HCOUNTRY GROUP    EQUATION     SHIFT       YEAR    YE LPRT151
     1AR)                                                               LPRT152
 5350 FORMAT (1H+,36X,53H_____________    ________     _____       ____   LPRT153
     1  ____)                                                           LPRT154
 5360 FORMAT (36X,4A4,2X,2A4,2X,2PF8.2,7X,I2,6X,I2)                     LPRT155
 5370 FORMAT (1H )                                                      LPRT156
 5380 FORMAT (1H1,///)                                                  LPRT157
 5390 FORMAT (1H-,38X,35HYEAR    SUPPLY      DEMAND      PRICE)         LPRT158
 5400 FORMAT (39X,35H____    ______      ______      _____)             LPRT159
 5410 FORMAT (43X,I4,2X,F8.1,3X,F8.1,2X,F8.3)                           LPRT160
 5420 FORMAT (1H0,50X,13HMODIFIED CASE)                                 LPRT161
 5430 FORMAT (10X,2(24X,4A4,13X))                                       LPRT162
 5440 FORMAT (1H0,10X,2(8X,44HYEAR    SUPPLY      SCRAP    DEMAND      PRI LPRT163
     1CE))                                                              LPRT164
 5450 FORMAT (1H+,10X,2(8X,44H____    ______      _____    ______      ___ LPRT165
     1__))                                                              LPRT166
 5460 FORMAT (1X,10X,2(8X,I4,3(2X,F8.1),2X,F8.3))                       LPRT167
 5470 FORMAT (1H-,5X,2(18X,35HYEAR    SUPPLY      DEMAND      PRICE))   LPRT168
 5480 FORMAT (6X,2(18X,35H____    ______      ______      _____))       LPRT169
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 5490 FORMAT (6X,2(18X,I4,2X,F8.1,3X,F8.1,2X,F8.3))                    LPRT170
 5500 FORMAT (1HO,7X,122HNORTH AMERICA      SOUTH AMERICA          ASIA  LPRT171
     1          AFRICA              EUROPE              OCEANIA      CENTRALL LPRT172
     2Y PLANNED)                                                     LPRT173
 5510 FORMAT (7H YEAR  ,7(18HSUPPLY  DEMAND  ))                      LPRT174
 5520 FORMAT (7H+____  ,7(18H______  ______  ))                      LPRT175
 5530 FORMAT (1X,I4,1X,7(F7.1,1X,F7.1,3X))                           LPRT176
 5540 FORMAT (1HO,62X,5HWORLD,/)                                     LPRT177
 5550 FORMAT (44X,47HYEAR  PRODUCTION     SCRAP   CONSUMPTION  PRICE) LPRT178
 5560 FORMAT (1H+,43X,47H____  __________    _____   _________   _____ LPRT179
     1)                                                              LPRT180
 5570 FORMAT (44X,I4,3X,F8.1,4X,F7.1,3X,F8.1,3X,F7.3)                LPRT181
 5580 FORMAT (///,55X,20HSECONDARY PRODUCTION,/)                     LPRT182
 5590 FORMAT (40X,5HNORTH,4X,5HSOUTH,42X,9HCENTRALLY)                LPRT183
 5600 FORMAT (31X,73HYEAR    AMERICA  AMERICA    ASIA    AFRICA    EUROP LPRT184
     1E    OCEANIA    PLANNED)                                       LPRT185
 5610 FORMAT (1H+,30X,73H____      _______  _______    ____    ______    - LPRT186
     1_____   _______    _______)                                     LPRT187
 5620 FORMAT (31X,I4,3X,F7.1,3(2X,F7.1),2X,2(2X,F7.1),7X,3HN/A)      LPRT188
      END                                                            LPRT189
C*********************************************************************
C                                                                    *
C     SUBROUTINE PLOT                                                *
C  CALLED BY MAIN PROGRAM                                            *
C                                                                    *
C*********************************************************************
      SUBROUTINE PLOT(IMINRL,IVAR,N,IYRST,IPLT,ICTYPL)
      COMMON / AREOUT / OUTPUT (4,11,25), DOTVAR (4,10), PROOT (4),  PLOT001
     1 ICNT(25), IGRT(25), USRGRT(25), GROW(25)                      PLOT002
      COMMON / AREPRM / ICNTRY,IYR,IPRICE,IQDEM,IQSUP,IQSCP,IYRSIP,  PLOT003
     1 IYRFST, NIKCHK,  IWORLD, IANN, IEXCHK, INEW(3), IERROR(14),IPG, PLOT004
     2 ISVAR(20), ISLEN(20), KVAR(3), IEXTRA, CNEW(3,4), ISCALE(30)  PLOT005
      COMMON / AREANM / NAME (2,4), NAMSUB (2,4), NAMCNT (4,11),     PLOT006
     1  NAMEXT(2,5),NAMVAR(2,4), IYRSFT(20), SHIFT(20), ICTSHT(20),  PLOT007
     2  IVETLB(22,4),ISTAR,IBLANK,IHATCH,IBAR,IPLTVR(3,12),IPLTPR     PLOT008
      DIMENSION IOUT(60,42),VLAB(26),IYROUT(20)                      PLOT009
      DO 5010 I=1,42                                                 PLOT010
      DO 5010 J=1,60                                                 PLOT011
         IOUT(J,I)=IBLANK                                            PLOT012
 5010 CONTINUE                                                       PLOT013
      ILEN=60                                                        PLOT014
      IF (IPLT.EQ.1) GO TO 5020                                      PLOT015
      IHGT=20                                                        PLOT016
      HGHT=20.0                                                      PLOT017
      GO TO 5030                                                     PLOT018
 5020 CONTINUE                                                       PLOT019
      IHGT=40                                                        PLOT020
      HGHT=40.0                                                      PLOT021
 5030 CONTINUE                                                       PLOT022
      IPITER=IHGT+2                                                  PLOT023
      IVAXIS=IPITER-1                                                PLOT024
      DO 5040 J=1,60                                                 PLOT025
         IOUT(J,IVAXIS)=IBAR                                         PLOT026
 5040 CONTINUE                                                       PLOT027
      IHTICK=4                                                       PLOT028
      IHINC=1                                                        PLOT029
      IHINC2=4                                                       PLOT030
      IF (N.GE.17.AND.N.LE.20) IHTICK=3                              PLOT031
      IF (21.LE.N) IHINC=2                                           PLOT032
      IF (N.GE.17.AND.N.LE.20) IHINC2=3                              PLOT033
                                                                     PLOT034
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      IF (21.LE.N.AND.N.LE.40) IHINC2=2                                 PLOT035
      IF (41.LE.N) IHINC2=1                                             PLOT036
      K=(ILEN/IHTICK)                                                   PLOT037
      IX=IYFST                                                          PLOT038
      DO 5050 I=1,K                                                     PLOT039
         J=((I-1)*IHTICK)+1                                             PLOT040
         IOUT(J,IPITER)=IHATCH                                          PLOT041
         IYROUT(I)=MOD(IX,100)                                          PLOT042
         IX=IX+IHINC                                                    PLOT043
 5050 CONTINUE                                                          PLOT044
      CALL SCALE (IMINRL,IVAR,N,HGHT,ILEN,RMIN,RMAX,RINC,ICTYPL)        PLOT045
      IF (RINC.LE.0.0001) GO TO 5110                                    PLOT046
      DO 5060 I=1,N                                                     PLOT047
         J=((I-1)*IHINC2)+1                                             PLOT048
         IOUT(J,ISCALE(I))=ISTAR                                        PLOT049
 5060 CONTINUE                                                          PLOT050
      KK=(IHGT/2)+1                                                     PLOT051
      X=0.0                                                             PLOT052
      DO 5070 I=1,KK                                                    PLOT053
         VLAB(I)=RMAX-(2*X)                                             PLOT054
         X=X+RINC                                                       PLOT055
 5070 CONTINUE                                                          PLOT056
      IF (IPLT.NE.1) GO TO 5090                                         PLOT057
      WRITE (6,5120) (NAMCNT(I,ICTYPL),I=1,4)                           PLOT058
      WRITE (6,5140) (IVETLB(I,IVAR),I=1,6)                             PLOT059
      WRITE (6,5290)                                                    PLOT060
      DO 5080 I=1,IVAXIS                                                PLOT061
         KK=MOD(I,2)                                                    PLOT062
         LL=(I/2)+1                                                     PLOT063
         IF (KK.NE.0.AND.IVAR.EQ.4) WRITE (6,5160) VLAB(LL),(IOUT(J,I),  PLOT064
     1      J=1,ILEN)                                                   PLOT065
         IF (KK.NE.0.AND.IVAR.NE.4) WRITE (6,5180) VLAB(LL),(IOUT(J,I),  PLOT066
     1      J=1,ILEN)                                                   PLOT067
         IF (KK.EQ.0) WRITE (6,5200) (IOUT(J,I),J=1,ILEN)               PLOT068
 5080 CONTINUE                                                          PLOT069
      WRITE (6,5260) (IOUT(J,IPITER),J=1,ILEN)                          PLOT070
      IF (IHTICK.EQ.4) WRITE (6,5220) (IYROUT(J),J=1,K)                 PLOT071
      IF (IHTICK.EQ.3) WRITE (6,5240) (IYROUT(I),I=1,K)                 PLOT072
      WRITE (6,5280)                                                    PLOT073
      WRITE (6,5270) (NAME(I,IMINRL),I=1,2)                             PLOT074
      GO TO 5110                                                        PLOT075
 5090 CONTINUE                                                          PLOT076
      WRITE (6,5130) (NAMCNT(I,ICTYPL),I=1,4)                           PLOT077
      DO 5100 I=1,IVAXIS                                                PLOT078
         KK=MOD(I,2)                                                    PLOT079
         LL=(I/2)+1                                                     PLOT080
         IF (KK.NE.0.AND.IVAR.EQ.4) WRITE (6,5150) IVETLB(I,IVAR),      PLOT081
     1      VLAB(LL),(IOUT(J,I),J=1,ILEN)                               PLOT082
         IF (KK.NE.0.AND.IVAR.NE.4) WRITE (6,5170) IVETLB(I,IVAR),      PLOT083
     1      VLAB(LL),(IOUT(J,I),J=1,ILEN)                               PLOT084
         IF (KK.EQ.0) WRITE (6,5190) IVETLB(I,IVAR),(IOUT(J,I),J=1,ILEN) PLOT085
 5100 CONTINUE                                                          PLOT086
      WRITE (6,5250) (IOUT(J,IPITER),J=1,ILEN)                          PLOT087
      IF (IHTICK.EQ.4) WRITE (6,5210) (IYROUT(J),J=1,K)                 PLOT088
      IF (IHTICK.EQ.3) WRITE (6,5230) (IYROUT(I),I=1,K)                 PLOT089
 5110 CONTINUE                                                          PLOT090
      RETURN                                                            PLOT091
 5120 FORMAT (1H1,///,51X,4A4)                                          PLOT092
 5130 FORMAT (1H1,31X,4A4)                                              PLOT093
 5140 FORMAT (1H0,56X,6A1)                                              PLOT094
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```
 5150 FORMAT (6X,A1,1X,F8.2,1X,2H-I,60A1)                                PLOT095
 5160 FORMAT (28X,F8.2,1X,2H-I,60A1)                                     PLOT096
 5170 FORMAT (6X,A1,1X,F8.1,1X,2H-I,60A1)                                PLOT097
 5180 FORMAT (28X,F8.1,1X,2H-I,60A1)                                     PLOT098
 5190 FORMAT (6X,A1,11X,1HI,60A1)                                        PLOT099
 5200 FORMAT (36X,1HI,60A1)                                              PLOT100
 5210 FORMAT (18X,16(I2,2X))                                             PLOT101
 5220 FORMAT (38X,16(I2,2X))                                             PLOT102
 5230 FORMAT (18X,21(I2,1X))                                             PLOT103
 5240 FORMAT (38X,21(I2,1X))                                             PLOT104
 5250 FORMAT (19X,60A1)                                                  PLOT105
 5260 FORMAT (39X,60A1)                                                  PLOT106
 5270 FORMAT (1H0,55X,2A4)                                               PLOT107
 5280 FORMAT (1HC,57X,4HYEAR)                                            PLOT108
 5290 FORMAT (1H0)                                                       PLOT109
      END                                                                PLOT110
C*************************************************************************
C                                                                        *
C     SUBROUTINE SCALE                                                   *
C                                                                        *
C  CALLED BY PLOT                                                        *
C                                                                        *
C*************************************************************************
      SUBROUTINE SCALE(IMINRL,IVAR,N,HGHT,ILEN,RMIN,RMAX,RINC,ICTYPL)    SCAL001
      COMMON / AREOUT / OUTPUT (4,11,25), OUTVAR (4,10), PROUT (4),      SCAL002
     1 ICNT(25), IGET(25), USRGET(25), GROW(25)                          SCAL003
      COMMON / AREPRM / ICNTRY,IYR,IPRICE,IQDEM,IQSUP,IQSCP,IYRSIM,      SCAL004
     1 IYRFST, NIKCHK,  IWORLD, IANN, IEXCHK, INEW(3), IERROR(14),IPG,   SCAL005
     2 ISVAR(20), ISLEN(20), KVAR(3), IEXTRA, CNEW(3,4), ISCALE(30)      SCAL006
      COMMON / AREANM / NAME (2,4), NAMSUB (2,4), NAMCNT (4,11),         SCAL007
     1  NAMEXT(2,5),NAMVAR(2,4), IYRSFT(20), SHIFT(20), ICTSHT(20),      SCAL008
     2  IVETLB(22,4),ISTAR,IBLANK,IHATCH,IBAR,IPLTVR(3,12),IPLTPR        SCAL009
      RMAX=0.0                                                           SCAL010
      RMIN=10000000000.0                                                 SCAL011
      DO 10 I=1,N                                                        SCAL012
         IF (OUTPUT(IVAR,ICTYPL,I).LT.RMIN) RMIN=OUTPUT(IVAR,ICTYPL,I)   SCAL013
         IF (OUTPUT(IVAR,ICTYPL,I).GT.RMAX) RMAX=OUTPUT(IVAR,ICTYPL,I)   SCAL014
   10 CONTINUE                                                           SCAL015
      MIN=IFIX(RMIN+.5)                                                  SCAL016
      MAX=IFIX(RMAX+.5)                                                  SCAL017
      RINC=(RMAX-RMIN)/HGHT                                              SCAL018
      IF (RINC.LE.0.0001) GO TO 30                                       SCAL019
      ADD=.5*RINC                                                        SCAL020
      DO 20 I=1,N                                                        SCAL021
         SCALER=((RMAX-OUTPUT(IVAR,ICTYPL,I))/RINC)                      SCAL022
         ISCALE(I)=IFIX(SCALER+.5)+1                                     SCAL023
   20 CONTINUE                                                           SCAL024
   30 CONTINUE                                                           SCAL025
      RETURN                                                             SCAL026
      END                                                                SCAL027
C*************************************************************************
C                                                                        *
C     THIS FUNCTION SUBPROGRAM IS USED TO CALCULATE VALUES FOR DEMAND,   *
C SCRAP, AND SUPPLY.                                                     *
C*************************************************************************
      FUNCTION GENADD(J,ICNT,IMINRL,IFUNC,ITER,X2,X3,X4,                 GADD001
     1  X5,X6,X7,X8,X9,X10,X11,X12,X13,X14,X15)                          GADD002
      COMMON / AREAGN / GENSUB(15,10,4,3),GSHIFT(50,10,3)                GADD003
      DIMENSION X(15)                                                    GADD004
      X(1)=1.0                                                           GADD005
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```
      X(2)=X2                                                          GADD006
      X(3)=X3                                                          GADD007
      X(4)=X4                                                          GADD008
      X(5)=X5                                                          GADD009
      X(6)=X6                                                          GADD010
      X(7)=X7                                                          GADD011
      X(8)=X8                                                          GADD012
      X(9)=X9                                                          GADD013
      X(10)=X10                                                        GADD014
      X(11)=X11                                                        GADD015
      X(12)=X12                                                        GADD016
      X(13)=X13                                                        GADD017
      X(14)=X14                                                        GADD018
      X(15)=X15                                                        GADD019
      GENADD=0.0                                                       GADD020
      DO 10 I=1,J                                                      GADD021
         GENADD=GENADD+(X(I)*GENSUB(I,ICNT,IMINRL,IFUNC))              GADD022
   10 CONTINUE                                                         GADD023
      GENADD=GENADD*GSHIFT(ITER,ICNT,IFUNC)                            GADD024
      RETURN                                                           GADD025
      END                                                              GADD026
C*****************************************************************
C                                                                    *
C     THIS FUNCTION SUBPROGRAM IS USED TO CALCULATE PRICE VALUES     *
C                                                                    *
C*****************************************************************
      FUNCTION PRCADD(IPRICE,IMINRL,ITER,X2,X3,X4,                     PADD001
     1  X5,X6,X7,X8,X9,X10,X11,X12,X13,X14,X15)                        PADD002
      COMMON / AREAPR / PRCSUB(15,4),PSHIFT(50),PRCHA(4)               PADD003
      DIMENSION X(15)                                                  PADD004
      X(1)=1.0                                                         PADD005
      X(2)=X2                                                          PADD006
      X(3)=X3                                                          PADD007
      X(4)=X4                                                          PADD008
      X(5)=X5                                                          PADD009
      X(6)=X6                                                          PADD010
      X(7)=X7                                                          PADD011
      X(8)=X8                                                          PADD012
      X(9)=X9                                                          PADD013
      X(10)=X10                                                        PADD014
      X(11)=X11                                                        PADD015
      X(12)=X12                                                        PADD016
      X(13)=X13                                                        PADD017
      X(14)=X14                                                        PADD018
      X(15)=X15                                                        PADD019
      PRCADD=0.0                                                       PADD020
      DO 10 I=1,IPRICE                                                 PADD021
         PRCADD=PRCADD+(X(I)*PRCSUB(I,IMINRL))                         PADD022
   10 CONTINUE                                                         PADD023
      PRCADD=PRCADD*PSHIFT(ITER)                                       PADD024
      RETURN                                                           PADD025
      END                                                              PADD026
C*****************************************************************
C                                                                    *
C                    INDEXING CONVENTIONS USED                       *
C                                                                    *
C   I. MINERALS                                                      *
C         DENOTED BY IMINRL IN DISCUSSION HENCEFORTH, AND IN PROGRAM.*
C         MAY BE ABBREVIATED AS IMIN OR IMN.                         *
C                                                                    *
```

```
C
C        MINERAL                IMINRL
C        COPPER                   1
C       ALUMINUM                  2
C        NICKEL                   3
C         ZINC                    4
C
C  II. COUNTRY GROUPS
C        DENOTED BY CGROUP IN DISCUSSION.
C        MAY BE ABBREVIATED AS CGRP OR CGP.
C
C        COUNTRY                ALPHABETIC          NUMERIC
C         GROUP                   INDEX             INDEX
C        NORTH AMERICA             NA                 1
C        SOUTH AMERICA             SA                 2
C        ASIA                      AS                 3
C        AFFICA                    AF                 4
C        EUROPE                    EU                 5
C        OCEANIA                   OC                 6
C        CENTRALLY PLANNED         CP                 7
C        EXPANSION GROUPS       XX,YY,ZZ           8,9,10
C
C  III. TIME
C        DENOTED BY T IN DISCUSSION
C
C        VALUE                  INDEX
C        CURRENT YEAR             1
C        LAGGED ONCE              2
C        LAGGED TWICE             3
C        LAGGED THRICE            4
C
C IV. EQUATION COEFFICIENTS
C
C        ABBREVIATED AS ICOEF
C        VALUES RUN FROM 1 TO 15
C
C-------------------------------------------------------------------
C              DESCRIPTION OF MAIN ARRAYS
C
C  I. HISTORICAL AND INSTITUTIONAL DATA
C
C        A.  EXOGENEOUS DATA
C
C     ARRAY    DIMENSION            DESCRIPTION
C
C   1. EXPARM T X I X CGROUP     INCOME AND INTEREST RATE LEVEL,
C             T=1,2; I=1,2,3,4;  GROWTH OF MONEY AND CAPITAL STOCKS
C   2. DOTVAR J X CGROUP         GROWTH RATES OF INCOME, INTEREST RATE,
C             J=1,2,3,4          CAPITAL STOCK, AND MONEY STOCK.
C   3. PRDOT  IMINRL             RATE OF PRICE CHANGE FOR SUBSTITUTES
C
C        B.  ENDOGENEOUS DATA
C
C     ARRAY    DIMENSION            DESCRIPTION
C
C   1. PRICE  I X T X IMINRL     PRICES OF MINERALS AND SUBSTITUTES
C   2. QDEM   T X CGRP. X IMIN.  QUANTITY DEMANDED OF EACH MINERAL
C   3. QSUP   T X CGRP X IMIN    QUANTITY OF PRIMARY PRODUCTION (SUPPLY)
C   4. QSCP   T X CGRP X IMIN    QUANTITY OF SECONDARY PRODUCTION (SCRAP)
C   5. QSPROD T X CGRP X IMIN    SUM OF PAST PRODUCTION
```

```
C
C  II. PROGRAM PARAMETERS
C
C        A.   INDICES AND COUNTERS
C             SEE DESCRIPTION BELOW
C
C        B.   EQUATION COEFFICIENTS
C
C      ARRAY   DIMENSION                    DESCRIPTION
C
C    1. PRCOEF ICOEF X IMINRL          PRICE EQUATION
C    2. DMCOEF ICOEF X CGP X IMN       DEMAND EQUATIONS
C    3. SRCOEF ICOEF X CGP X IMN       SCRAP EQUATIONS
C    4. SPCOEF ICOEF X CGP X IMN       SUPPLY EQUATIONS
C
C
C         AN ATTEMPT HAS BEEN MADE TO EQUIVALENCE THE LARGER OF
C    THESE ARRAYS TO SMALLER ARRAYS WITH EASILY UNDERSTOOD MNENOMIC
C    NAMES.
C-----------------------------------------------------------------------
C
C          EXPLANATION OF EQUIVALENCING
C
C  I. HISTORICAL AND EXOGENEOUS DATA
C
C         FOR BOTH EXPARM AND DOTVAR , THE FIRST SUBSCRIPT CORRESPONDS
C    TO A PARTICULAR VARIABLE AS FOLLOW:
C
C           VARIABLE                    INDEX (I FOR EXPARM, J FOR DOTVAR)
C           INCOME                                  1
C        INTEREST RATE                              2
C    GROWTH RATE OF CAPITAL STOCK                   3
C    GROWTH RATE OF MONEY STOCK                     4
C
C
C    A.    EXPARM
C
C             EXPARM CONTAINS THE LEVEL VALUES OF INCOME AND
C       THE INTEREST RATE. IT ALSO CONTAINS THE GROWTH RATES OF
C       MONEY STOCK AND CAPITAL STOCK.
C
C             IT IS EQUIVALENCED TO TEN 1-DIMENSIONAL ARRAYS, ONE FOR
C       EACH COUNTRY GROUP.  THESE ARRAYS ARE NAMED BY THE FOLLOWING
C
C                EXPJJ,
C
C       WHERE JJ IS THE ALPHABETIC COUNTRY GROUP INDEX.
C
C       LET YI = INCOME IN ITH TIME PERIOD,
C         RI = INTEREST RATE IN ITH TIME PERIOD
C         KI = GROWTH RATE OF CAPITAL STOCK IN ITH TIME PERIOD,
C    AND, MI = GROWTH RATE OF MONEY STOCK IN ITH TIME PERIOD.
C
C       THEN EACH VECTOR, EXPJJ , JJ=1,10, IS CONSTRUCTED AS FOLLOWS:
C
C    EXPJJ=(Y1,Y2,R1,R2,K1,K2,M1,M2) ,
C
C  WHERE THE SUBSCRIPTS FOLLOW THE TIME INDEXING CONVENTION
```

```
C  DESCRIBED ABOVE.
C
C
C  B. DOTVAR
C
C          DOTVAR CONTAINS THE GROWTH RATES OF INCOME, INTEREST
C     RATE, CAPITAL STOCK, AND MONEY STOCK.
C
C          DOTVAR IS EQUIVALENCED TO TEN 1-DIMENSIONAL ARRAYS
C     WITH NAMES AS FOLLOW:
C
C          CHAJJ,
C
C     WHERE JJ IS THE ALPHABETIC COUNTRY GROUP INDEX.
C
C          THEN EACH VECTOR, CHAJJ, JJ=1,20, IS CONSTRUCTED AS
C   FOLLOWS:
C
C     CHAJJ=(YDOT1,YDOT2,RDOT1,RDOT2,K1,K2,M1,M2),
C
C     WHERE YDOTJ IS RATE OF GROWTH OF INCOME IN THE JTH PERIOD,
C         RDOTJ IS RATE OF GROWTH OF INTEREST RATE IN THE JTH PERIOD,
C           AND MJ, KJ, AND TIME INDEXING ARE AS FOR EXPARM.
C
C
C  C. PRDOT
C
C          PRDOT IS NOT EQUIVALENCED TO ANY OTHER ARRAY, BEING ONLY
C     1-DIMENSIONAL.  IT IS CONSTRUCTED AS FOLLOWS:
C
C     PRDOT=(PRDOT1,PRDOT2,PRDOT3,PRDOT4),
C
C     WHERE THE FIRST ENTRY IS RATE OF PRICE CHANGE FOR ALUMINUM, THE
C     SUBSTITUTE FOR COPPER, THE SECOND ENTRY IS RATE OF PRICE CHANGE
C     FOR COPPER THE SUBSTITUTE FOR ALUMINUM, AND THE THIRD AND FOURTH
C     ENTRIES ARE THE RATE OF PRICE CHANGE FOR STEEL, THE SUBSTITUTE
C     FOR BOTH NICKEL AND ZINC.
C
C
C  D. PRICE
C
C          PRICE IS THE ARRAY OF PRICE VALUES FOR THE FOUR MINERALS
C     PLUS THE FOUR SUBSTITUTES.  IT IS NOT EQUIVALENCE TO ANY
C     ARRAYS. IT IS CONSTRUCTED AS FOLLOWS:
C
C  LET PIJ = THE PRICE OF THE ITH MINERAL IN THE JTH TIME PERIOD, AND
C     PRIJ = THE PRICE OF THE SUBSTITUTE FOR THE ITH MINERAL IN THE
C          JTH TIME PERIOD,
C  THEN
C     PRICE=(P11,PR11,P12,PR12,P13,PR13, ------,P43,PR43) .
C
C
C  E.  QDEM
C
C          QDEM CONTAINS THE VALUES OF DEMAND FOR THE TEN COUNTRY
C     GROUPS FOR FOUR TIME PERIODS.  IT IS EQUIVALENCED TO FOUR 1-
C     DIMENSIONAL ARRAYS, NAMED AS FOLLOWS:
C
C          QDEMI ,  I = 1,2,3,4,
C
```

```
C      WHERE I IS THE MINERAL INDEX.
C
C            EACH OF THE ARRAYS QDEMI, I=1,2,3,4, IS CONSTRUCTED AS
C      FOLLOWS:
C
C      LET DJK = DEMAND FOR THE ITH MINERAL FROM THE JTH COUNTRY GROUP
C                FOR THE KTH YEAR,
C    THEN
C            QDEMI=(D(1,1),D(1,2),D(1,3),D(1,4),----,D(10,4)).
C
C
C  F.  QSUP
C
C            QSUP CONTAINS THE VALUES OF PRIMARY PRODUCTION (SUPPLY)
C      FOR THE TEN COUNTRY GROUPS FOR TWO TIME PERIODS.
C      EQUIVALENCED TO FOUR 1-DIMENSIONAL ARRAYS, NAMED AS FOLLOWS:
C
C            QSUPI , I = 1,2,3,4,
C
C      WHERE I IS THE MINERAL INDEX.
C
C            EACH OF THE ARRAYS QSUPI, I=1,2,3,4, IS CONSTRUCTED AS
C      FOLLOWS:
C
C      LET SJK = DEMAND FOR THE ITH MINERAL FROM THE JTH COUNTRY GROUP
C                FOR THE KTH YEAR,
C      THEN
C      QSUPI=(S1,1),S(1,2),S(2,1),S(2,2),---------,S(10,1),S(10,2).
C
C
C  G.  QSCP
C
C            QSCP CONTAINS THE VALUES OF SECONDARY PRODUCTION (SCRAP)
C      FOR THE TEN COUNTRY GROUPS FOR TWO TIME PERIODS.  IT IS
C      EQUIVALENCED TO FOUR 1-DIMENSIONAL ARRAYS, NAMED AS FOLLOWS:
C
C            QSCPI , I=1,2,3,4,
C
C      WHERE I IS THE MINERAL INDEX.
C
C            EACH OF THE ARRAYS QSCPI, I=1,2,3,4, IS CONSTRUCTED
C      AS THE QSUPI ABOVE.
C
C
C  H.  QSPROD
C
C            QSPROD CONTAINS THE SUM OF PAST PRODUCTION FOR THE
C      TEN COUNTRY GROUPS FOR TWO TIME PERIODS. THE VALUE FOR EACH
C      TIME PERIOD IS THE SUM OF PRODUCTION UP TO TIME, T-2. QSPROD
C      IS EQUIVALENCED TO FOUR 1-DIMENSIONAL ARRAYS , NAMED AS FOLLOWS:
C
C            QSPRDI , I=1,2,3,4
C
C      WHERE I IS THE MINERAL INDEX.
C
C            EACH OF THE ARRAYS QSPRDI, I=1,2,3,4, IS CONSTRUCTED
C      AS THE QSUPI ABOVE.
C
C
C
```

```
C II. EQUATION COEFFICIENTS
C
C       A. PRCOEF -- COEFFICIENTS OF PRICE EQUATIONS
C
C             PRCOEF IS EQUIVALENCE TO FOUR 1-DIMENSIONAL ARRAYS,
C       NAMED AS FOLLOWS:
C
C             PRCFI, I=1,2,3,4;
C
C       WHERE I IS THE MINERAL INDEX.
C
C             EACH OF THE ARRAYS, PRCFI , IS CONSTRUCTED AS FOLLOWS:
C
C       LET AJ = THE JTH COEFFICIENT IN THE EQUATION FOR THE PRICE
C       OF THE ITH MINERAL, THEN
C
C       PRCFI=(A1,A2,A3,---------,A14,A15).
C
C       B. DMCOEF,SRCOEF,SPCOEF
C
C             THESE THREE ARRAYS ARE EQUIVALENCED IN IDENTICAL MANNER
C       TO 4C 1-DIMENSIONAL ARRAYS, ONE FOR EACH COUNTRY GROUP FOR EACH
C       MINERAL, WHICH ARE NAMED IN THE FOLLOWING MANNER:
C
C             DMCGI , I=1,2,3,4; FOR DMCOEF,
C             SRCGI , I=1,2,3,4; FOR SRCOEF,
C             SPCGI , I=1,2,3,4; FOR SPCOEF;
C
C       WHERE CG IS THE ALPHABETIC COUNTRY GROUP INDEX.
C
C       THESE ARRAYS ARE CONSTRUCTED SIMILARLY TO THE PRCFI ABOVE.
C
C
C-----------------------------------------------------------------------
C
C             LISTING OF PROGRAM COUNTERS AND PARAMETERS
C
C       VARIABLE    FUNCTION                  DEFAULT VALUE
C       IYR         BEG. CALCULATION YEAR        80
C       IYRFST      BEG. OUTPUT YEAR             81
C       IYRSIM      # OF YEARS TO SIMULATE       10
C                   STARTING WITH IYRFST
C       ICNTRY      DIM. OF ACTIVE COUN. GRPS    7
C       IWORLD      INDEX FOR WORLD              8
C       IPRICE      # OF COEFFICIENTS IN         11
C                   PRICE EQUATION
C       IQDEM       # OF COEFFICIENTS IN         10
C                   DEMAND EQUATIONS
C       IQSUP       # OF COEFFICIENTS IN         13
C                   SUPPLY EQUATIONS
C       IQSCP       # OF COEFFICIENTS IN         13
C                   SCRAP EQUATIONS
C
C NOTE:  THESE PARAMETERS HAVE THEIR DEFAULT VALUES SET
C       IN THE LAST TWO CARDS IN THE BLOCK DATA SUBROUTINE.
C
C
C
C
C
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C                    EQUATION PARAMETER                                    *
C                     CROSS REFERENCE                                      *
C                                                                          *
C COEF.                                EQUATION                            *
C NUMB.  PRICE              DEMAND              SCRAP             SUPPLY   *
C  1     CONSTANT           CONSTANT            CONSTANT          CONSTANT *
C  2     PRICE(T-1)         PRICEDIF(T)         PRICE(T)          PRICE(T) *
C  3     PRICE(T-2)         PRICEDIF(T-1)       PRICE(T-1)        PRICE(T-1)*
C  4     EXCESS SUPPLY      PRICEDIF(T-2)       PRICE(T-2)        PRICE(T-2)*
C        INCL. SCRAP                                                       *
C        FOR T-1                                                           *
C  5     WSSUM(T-1)         EXCESS SUPPLY       QDEM(T)           ROWS(T-1)*
C                           W/O SCRAP (T-1)                               *
C  6     T                  INCOME(T)           QDEM(T-1)         WORDEM(T)*
C  7     NA INCOME(T)       INCOME(T-1)         QDEM(T-2)         WORDEM(T-1)*
C  8     NA INTEREST        CAPITAL GROWTH      QDEM(T-3)         WORDEM(T-2)*
C        RATE(T)            RATE(T-1)                                     *
C  9     PREL(T)            MONEY GROWTH        QSCP(T-1)         T        *
C                           RATE(T-1)                                     *
C 10     PREL(T-1)          QDEM(T-1)           WORDEM(T)         INTEREST RATE(T)*
C 11     PREL(T-2)          NOT USED            WORDEM(T-1)       INTER. RATE(T-2)*
C 12     NOT USED           NOT USED            WORDEM(T-2)       QSPROD(T)*
C 13     NOT USED           NOT USED            WORDEM(T-3)       QSUP(T-1)*
C 14     NOT USED           NOT USED            NOT USED          NOT USED *
C 15     NOT USED           NOT USED            NOT USED          NOT USED *
C                                                                          *
C**************************************************************************
      BLOCK DATA                                                          BLCK001
      COMMON / AREOUT / OUTPUT (4,11,25), DOTVAR (4,10), PRDOT (4),       BLCK002
     1 ICNT(25), IGRT(25), USRGRT(25), GROW(25)                           BLCK003
      COMMON / AREAPR / PRCOEF(15,4),PSHIFT(50),PRCHA(4)                  BLCK004
      COMMON / ARPRIC / PRICE(2,3,4)                                      BLCK005
      COMMON / AREEXP / EXPARM(2,4,10),WPI                                BLCK006
      COMMON / AREAGN / DMCOEF(15,10,4),SRCOEF(15,10,4),                  BLCK007
     1 SPCOEF(15,10,4),SHFT(50,30)                                        BLCK008
      COMMON / AREDAT / QDEM(4,10,4),QSUP(2,10,4),QSCP(2,10,4),           BLCK009
     1 QSPROD(2,10,4)                                                     BLCK010
      COMMON / AREANM / NAME (2,4), NAMSUB (2,4), NAMCNT (4,11),          BLCK011
     1  NAMEXT(2,5),NAMVAR(2,4), IYRSFT(20), SHIFT(20), ICTSHT(20),       BLCK012
     2  IVETLB(22,4),ISTAR,IBLANK,IHATCH,IBAR,IPLTVR(3,12),IPLTPR         BLCK013
      COMMON / AREPRM / ICNTRY,IYR,IPRICE,IQDEM,IQSUP,IQSCP,IYRSIM,       BLCK014
     1 IYRFST, NIKCHK,  IWORLD, IANN, IEXCHK, INEW(3), IERROR(14),IPG,    BLCK015
     2 ISVAR(20), ISLEN(20), KVAR(3), IEXTRA, CNEW(3,4), ISCALE(30)       BLCK016
      DIMENSION PRCF1(15),PRCF2(15),PRCF3(15),PRCF4(15),PRCF5(15)         BLCK017
      DIMENSION EXPNA(2,4),EXPSA(2,4),EXPAS(2,4),EXPAF(2,4),EXPEU(2,4),   BLCK018
     1EXPOC(2,4),EXPCP(2,4),EXPXX(2,4),EXPYY(2,4),EXPZZ(2,4)              BLCK019
      DIMENSION CHANA(4),CHASA(4),CHAAS(4),CHAAF(4),                      BLCK020
     1CHAEU(4),CHAOC(4),CHACP(4),CHAXX(4),CHAYY(4),CHAZZ(4)               BLCK021
      DIMENSION SPNA1(15),SPSA1(15),SPAS1(15),SPAF1(15),SPEU1(15),        BLCK022
     1SPOC1(15),SPCP1(15),SPXX1(15),SPYY1(15),SPZZ1(15)                   BLCK023
      DIMENSION SPNA2(15),SPSA2(15),SPAS2(15),SPAF2(15),SPEU2(15),        BLCK024
     1SPOC2(15),SPCP2(15),SPXX2(15),SPYY2(15),SPZZ2(15)                   BLCK025
      DIMENSION SPNA3(15),SPSA3(15),SPAS3(15),SPAF3(15),SPEU3(15),        BLCK026
     1SPOC3(15),SPCP3(15),SPXX3(15),SPYY3(15),SPZZ3(15)                   BLCK027
      DIMENSION SPNA4(15),SPSA4(15),SPAS4(15),SPAF4(15),SPEU4(15),        BLCK028
     1SPOC4(15),SPCP4(15),SPXX4(15),SPYY4(15),SPZZ4(15)                   BLCK029
      DIMENSION DMNA1(15),DMSA1(15),DMAS1(15),DMAF1(15),DMEU1(15),        BLCK030
     1DMOC1(15),DMCP1(15),DMXX1(15),DMYY1(15),DMZZ1(15)                   BLCK031
      DIMENSION DMNA2(15),DMSA2(15),DMAS2(15),DMAF2(15),DMEU2(15),        BLCK032
     1DMOC2(15),DMCP2(15),DMXX2(15),DMYY2(15),DMZZ2(15)                   BLCK033
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      DIMENSION DMNA3(15),DMSA3(15),DMAS3(15),DMAF3(15),DMEU3(15),          BLCK034
     1DMOC3(15),DMCP3(15),DMXX3(15),DMYY3(15),DMZZ3(15)                     BLCK035
      DIMENSION DMNA4(15),DMSA4(15),DMAS4(15),DMAF4(15),DMEU4(15),          BLCK036
     1DMOC4(15),DMCP4(15),DMXX4(15),DMYY4(15),DMZZ4(15)                     BLCK037
      DIMENSION SRNA1(15),SRSA1(15),SRAS1(15),SRAF1(15),SREU1(15),          BLCK038
     1SROC1(15),SRCP1(15),SRXX1(15),SRYY1(15),SRZZ1(15)                     BLCK039
      DIMENSION SRNA2(15),SRSA2(15),SRAS2(15),SRAF2(15),SREU2(15),          BLCK040
     1SROC2(15),SRCP2(15),SRXX2(15),SRYY2(15),SRZZ2(15)                     BLCK041
      DIMENSION SRNA3(15),SRSA3(15),SRAS3(15),SRAF3(15),SREU3(15),          BLCK042
     1SROC3(15),SRCP3(15),SRXX3(15),SRYY3(15),SRZZ3(15)                     BLCK043
      DIMENSION SRNA4(15),SRSA4(15),SRAS4(15),SRAF4(15),SREU4(15),          BLCK044
     1SROC4(15),SRCP4(15),SRXX4(15),SRYY4(15),SRZZ4(15)                     BLCK045
      DIMENSION QDEM1(4,10),QDEM2(4,10),QDEM3(4,10),QDEM4(4,10)             BLCK046
      DIMENSION QSUP1(2,10),QSUP2(2,10),QSUP3(2,10),QSUP4(2,10)             BLCK047
      DIMENSION QSCP1(2,10),QSCP2(2,10),QSCP3(2,10),QSCP4(2,10)             BLCK048
      DIMENSION QSPRD1(2,10),QSPRD2(2,10),QSPRD3(2,10),QSPRD4(2,10)         BLCK049
      EQUIVALENCE (PRCOEF(1,1),PRCF1(1)),(PRCOEF(1,2),PRCF2(1)),            BLCK050
     1 (PRCOEF(1,3),PRCF3(1)),(PRCOEF(1,4),PRCF4(1))                        BLCK051
      EQUIVALENCE (EXPARM(1,1,1),EXPNA(1)),(EXPARM(1,1,2),EXPSA(1)),        BLCK052
     1(EXPARM(1,1,3),EXPAS(1)),(EXPARM(1,1,4),EXPAF(1)),                    BLCK053
     2(EXPARM(1,1,5),EXPEU(1)),(EXPARM(1,1,6),EXPOC(1)),                    BLCK054
     3(EXPARM(1,1,7),EXPCP(1)),(EXPARM(1,1,8),EXPXX(1)),                    BLCK055
     4(EXPARM(1,1,9),EXPYY(1)),(EXPARM(1,1,10),EXPZZ(1))                    BLCK056
      EQUIVALENCE (DOTVAR(1,1),CHANA(1)),(DOTVAR(1,2),CHASA(1)),            BLCK057
     1(DOTVAR(1,3),CHAAS(1)),(DOTVAR(1,4),CHAAF(1)),                        BLCK058
     2(DOTVAR(1,5),CHAEU(1)),(DOTVAR(1,6),CHAOC(1)),                        BLCK059
     3(DOTVAR(1,7),CHACP(1)),(DOTVAR(1,8),CHAXX(1)),                        BLCK060
     4(DOTVAR(1,9),CHAYY(1)),(DOTVAR(1,10),CHAZZ(1))                        BLCK061
      EQUIVALENCE (SPCOEF(1,1,1),SPNA1(1)),(SPCOEF(1,2,1),SPSA1(1)),        BLCK062
     1(SPCOEF(1,3,1),SPAS1(1)),(SPCOEF(1,4,1),SPAF1(1)),                    BLCK063
     2(SPCOEF(1,5,1),SPEU1(1)),(SPCOEF(1,6,1),SPOC1(1)),                    BLCK064
     3(SPCOEF(1,7,1),SPCP1(1)),(SPCOEF(1,8,1),SPXX1(1)),                    BLCK065
     4(SPCOEF(1,9,1),SPYY1(1)),(SPCOEF(1,10,1),SPZZ1(1))                    BLCK066
      EQUIVALENCE (SPCOEF(1,1,2),SPNA2(1)),(SPCOEF(1,2,2),SPSA2(1)),        BLCK067
     1(SPCOEF(1,3,2),SPAS2(1)),(SPCOEF(1,4,2),SPAF2(1)),                    BLCK068
     2(SPCOEF(1,5,2),SPEU2(1)),(SPCOEF(1,6,2),SPOC2(1)),                    BLCK069
     3(SPCOEF(1,7,2),SPCP2(1)),(SPCOEF(1,8,2),SPXX2(1)),                    BLCK070
     4(SPCOEF(1,9,2),SPYY2(1)),(SPCOEF(1,10,2),SPZZ2(1))                    BLCK071
      EQUIVALENCE (SPCOEF(1,1,3),SPNA3(1)),(SPCOEF(1,2,3),SPSA3(1)),        BLCK072
     1(SPCOEF(1,3,3),SPAS3(1)),(SPCOEF(1,4,3),SPAF3(1)),                    BLCK073
     2(SPCOEF(1,5,3),SPEU3(1)),(SPCOEF(1,6,3),SPOC3(1)),                    BLCK074
     3(SPCOEF(1,7,3),SPCP3(1)),(SPCOEF(1,8,3),SPXX3(1)),                    BLCK075
     4(SPCOEF(1,9,3),SPYY3(1)),(SPCOEF(1,10,3),SPZZ3(1))                    BLCK076
      EQUIVALENCE (SPCOEF(1,1,4),SPNA4(1)),(SPCOEF(1,2,4),SPSA4(1)),        BLCK077
     1(SPCOEF(1,3,4),SPAS4(1)),(SPCOEF(1,4,4),SPAF4(1)),                    BLCK078
     2(SPCOEF(1,5,4),SPEU4(1)),(SPCOEF(1,6,4),SPOC4(1)),                    BLCK079
     3(SPCOEF(1,7,4),SPCP4(1)),(SPCOEF(1,8,4),SPXX4(1)),                    BLCK080
     4(SPCOEF(1,9,4),SPYY4(1)),(SPCOEF(1,10,4),SPZZ4(1))                    BLCK081
      EQUIVALENCE (DMCOEF(1,1,1),DMNA1(1)),(DMCOEF(1,2,1),DMSA1(1)),        BLCK082
     1(DMCOEF(1,3,1),DMAS1(1)),(DMCOEF(1,4,1),DMAF1(1)),                    BLCK083
     2(DMCOEF(1,5,1),DMEU1(1)),(DMCOEF(1,6,1),DMOC1(1)),                    BLCK084
     3(DMCOEF(1,7,1),DMCP1(1)),(DMCOEF(1,8,1),DMXX1(1)),                    BLCK085
     4(DMCOEF(1,9,1),DMYY1(1)),(DMCOEF(1,10,1),DMZZ1(1))                    BLCK086
      EQUIVALENCE (DMCOEF(1,1,2),DMNA2(1)),(DMCOEF(1,2,2),DMSA2(1)),        BLCK087
     1(DMCOEF(1,3,2),DMAS2(1)),(DMCOEF(1,4,2),DMAF2(1)),                    BLCK088
     2(DMCOEF(1,5,2),DMEU2(1)),(DMCOEF(1,6,2),DMOC2(1)),                    BLCK089
     3(DMCOEF(1,7,2),DMCP2(1)),(DMCOEF(1,8,2),DMXX2(1)),                    BLCK090
     4(DMCOEF(1,9,2),DMYY2(1)),(DMCOEF(1,10,2),DMZZ2(1))                    BLCK091
      EQUIVALENCE (DMCOEF(1,1,3),DMNA3(1)),(DMCOEF(1,2,3),DMSA3(1)),        BLCK092
     1(DMCOEF(1,3,3),DMAS3(1)),(DMCOEF(1,4,3),DMAF3(1)),                    BLCK093
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     2(DMCOEF(1,5,3),DMEU3(1)),(DMCOEF(1,6,3),DMOC3(1)),                BLCK094
     3(DMCOEF(1,7,3),DMCP3(1)),(DMCOEF(1,8,3),DMXX3(1)),                BLCK095
     4(DMCOEF(1,9,3),DMYY3(1)),(DMCOEF(1,10,3),DMZZ3(1))                BLCK096
      EQUIVALENCE (DMCOEF(1,1,4),DMNA4(1)),(DMCOEF(1,2,4),DMSA4(1)),    BLCK097
     1(DMCOEF(1,3,4),DMAS4(1)),(DMCOEF(1,4,4),DMAF4(1)),                BLCK098
     2(DMCOEF(1,5,4),DMEU4(1)),(DMCOEF(1,6,4),DMOC4(1)),                BLCK099
     3(DMCOEF(1,7,4),DMCP4(1)),(DMCOEF(1,8,4),DMXX4(1)),                BLCK100
     4(DMCOEF(1,9,4),DMYY4(1)),(DMCOEF(1,10,4),DMZZ4(1))                BLCK101
      EQUIVALENCE (SRCOEF(1,1,1),SRNA1(1)),(SRCOEF(1,2,1),SRSA1(1)),    BLCK102
     1(SRCOEF(1,3,1),SRAS1(1)),(SRCOEF(1,4,1),SRAF1(1)),                BLCK103
     2(SRCOEF(1,5,1),SREU1(1)),(SRCOEF(1,6,1),SROC1(1)),                BLCK104
     3(SRCOEF(1,7,1),SRCP1(1)),(SRCOEF(1,8,1),SRXX1(1)),                BLCK105
     4(SRCOEF(1,9,1),SRYY1(1)),(SRCOEF(1,10,1),SRZZ1(1))                BLCK106
      EQUIVALENCE (SRCOEF(1,1,2),SRNA2(1)),(SRCOEF(1,2,2),SRSA2(1)),    BLCK107
     1(SRCOEF(1,3,2),SRAS2(1)),(SRCOEF(1,4,2),SRAF2(1)),                BLCK108
     2(SRCOEF(1,5,2),SREU2(1)),(SRCOEF(1,6,2),SROC2(1)),                BLCK109
     3(SRCOEF(1,7,2),SRCP2(1)),(SRCOEF(1,8,2),SRXX2(1)),                BLCK110
     4(SRCOEF(1,9,2),SRYY2(1)),(SRCOEF(1,10,2),SRZZ2(1))                BLCK111
      EQUIVALENCE (SRCOEF(1,1,3),SRNA3(1)),(SRCOEF(1,2,3),SRSA3(1)),    BLCK112
     1(SRCOEF(1,3,3),SRAS3(1)),(SRCOEF(1,4,3),SRAF3(1)),                BLCK113
     2(SRCOEF(1,5,3),SREU3(1)),(SRCOEF(1,6,3),SROC3(1)),                BLCK114
     3(SRCOEF(1,7,3),SRCP3(1)),(SRCOEF(1,8,3),SRXX3(1)),                BLCK115
     4(SRCOEF(1,9,3),SRYY3(1)),(SRCOEF(1,10,3),SRZZ3(1))                BLCK116
      EQUIVALENCE (SRCOEF(1,1,4),SRNA4(1)),(SRCOEF(1,2,4),SRSA4(1)),    BLCK117
     1(SRCOEF(1,3,4),SRAS4(1)),(SRCOEF(1,4,4),SRAF4(1)),                BLCK118
     2(SRCOEF(1,5,4),SREU4(1)),(SRCOEF(1,6,4),SROC4(1)),                BLCK119
     3(SRCOEF(1,7,4),SRCP4(1)),(SRCOEF(1,8,4),SRXX4(1)),                BLCK120
     4(SRCOEF(1,9,4),SRYY4(1)),(SRCOEF(1,10,4),SRZZ4(1))                BLCK121
      EQUIVALENCE (QDEM(1,1,1),QDEM1(1)),(QDEM(1,1,2),QDEM2(1)),        BLCK122
     1 (QDEM(1,1,3),QDEM3(1)),(QDEM(1,1,4),QDEM4(1))                    BLCK123
      EQUIVALENCE (QSUP(1,1,1),QSUP1(1)),(QSUP(1,1,2),QSUP2(1)),        BLCK124
     1 (QSUP(1,1,3),QSUP3(1)),(QSUP(1,1,4),QSUP4(1))                    BLCK125
      EQUIVALENCE (QSCP(1,1,1),QSCP1(1)),(QSCP(1,1,2),QSCP2(1)),        BLCK126
     1 (QSCP(1,1,3),QSCP3(1)),(QSCP(1,1,4),QSCP4(1))                    BLCK127
      EQUIVALENCE (QSPROD(1,1,1),QSPRD1(1)),(QSPROD(1,1,2),QSPRD2(1)),  BLCK128
     1 (QSPROD(1,1,3),QSPRD3(1)),(QSPROD(1,1,4),QSPRD4(1))              BLCK129
C*********************************************************************
C                                                                     *
C                                                                     *
C    SET UP INTEGER ARRAYS WITH NAMES FOR PRINT FORMATTING.           *
C                                                                     *
C*********************************************************************
      DATA NAME / 4H COP, 4HPER , 4HALUM, 4HINUM, 4H NIC, 4HKEL ,      BLCK130
     1 4H  ZI, 4HNC  /                                                 BLCK131
      DATA NAMSUB / 4HALUM, 4HINUM, 4H COP, 4HPER , 4H  ST, 4HEEL ,    BLCK132
     1 4H  ST, 4HEEL  /                                                BLCK133
      DATA NAMCNT / 4H  NO, 4HRTH , 4HAMER, 4HICA , 4H  SO, 4HUTH ,    BLCK134
     1 4HAMER, 4HICA , 4H    , 4H  AS, 4HIA  , 4H    , 4H    ,        BLCK135
     2 4H AFR, 4HICA , 4H    , 4H    , 4H EUR, 4HOPE , 4H    ,        BLCK136
     3  4H    , 4HOCEA, 4HNIA , 4H    , 4HCENT,                       BLCK137
     4 4HRAL , 4HPLAN, 4HNED , 4H    , 4H  WO, 4HRLD , 4H    , 12*0 /  BLCK138
      DATA NAMEXT / 4H INC, 4HOME , 4HINTE, 4HREST, 4H CAP, 4HITAL,    BLCK139
     1  4H  NO, 4HNEY , 4HSUBS, 4H*UTE                                 BLCK140
      DATA NAMVAR / 4H SUP, 4HPLY , 4H  SC, 4HRAP , 4H DEM, 4HAND ,    BLCK141
     1  4H  PR, 4HICE    /                                            BLCK142
      DATA IVETLB /  1HS, 1HU, 1HP, 1HP, 1HL, 1HY,                     BLCK143
     1  16** *, 1HS, 1HC, 1HR, 1HA, 1HP, 1H ,                         BLCK144
     2  16** *, 1HD, 1HE, 1HM, 1HA, 1HN, 1HD,                         BLCK145
     3  16** *, 1HP, 1HR, 1HI, 1HC, 1HE, 1H , 16** * /                BLCK146
      DATA ISTAR, IBLANK, IHATCH, IBAR / 1H* , 1H  ,1HI, 1H- /         BLCK147
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      DATA KVAR / 2, 1, 0 /                                                    BLCK148
      DATA PSHIFT,SHFT,CNEW,WPI / 1550*1.0, 12*0.0, 2.356 /                    BLCK149
      DATA IEXCHK,INEd,IERROR,NIKCHK,ISCALE,IPLTVR,IPLTPR / 8o*0 /             BLCK150
      DATA OUTPUT,USRGRT,GROW,PRCHA,SHIFT / 1174*0.0 /                         BLCK151
      DATA ICNT,IGFT,IANN,IPG,ISVAR,ISLEN,IEXTRA,IYPSFT,ICTSHT / 133*0 /       BLCK152
C*************************************************************************
C                                                                         *
C         NOW SET UP SUPPLY COEFFICIENTS                                  *
C                                                                         *
C*************************************************************************
      DATA SPNA1 / -1o18.74  , 1.7507, 8.0598, 0.0, 0.8980, 0.4173,            BLCK153
     1 -0.4148, 0.0, 13.3183, 0.0, 0.0, -0.0886, 0.5139, 2*0.0 /               BLCK154
      DATA SPSA1/ 138.9997, 1.1722, -2.9267, 5*0.0, 2.5541, 2*0.0,             BLCK155
     1 0.0202, .5079, 2*0.0 /                                                  BLCK156
      DATA SPAS1 / 12o.3457, 0.0, .7445, 0.0, .0303, .0253, -0.0344,           BLCK157
     1 0.0, -2.8o89, 2*0.0, .0134, .6643, 2*0.0 /                              BLCK158
      DATA SPAF1 / -124.651, 2.0266, -0.69O6, 0.0, -.0297, 3*0.0,              BLCK159
     1 3.9813, 3*0.0, .9612, 2*0.0 /                                           BLCK160
      DATA SPEU1 / -10.4089, 0.0, .3425, 2*0.0, .0106, -.0108,                 BLCK161
     1 5*0.0, 0.9811, 2*0.0 /                                                  BLCK162
      DATA SPDC1 / 307.2846, 3*0.0, .0011, .0024, .0031, 5*0.0,                BLCK163
     1 .1197, 2*0.0 /                                                          BLCK164
      DATA SPCP1 / -302.012, 0.0, 1.0004, 5*0.0,  5.9124, 2*0.0,               BLCK165
     1 -.0009, .9256, 2*0.0 /                                                  BLCK166
      DATA SPXX1,SPYY1,SPZZ1 /  45*0.0 /                                       BLCK167
      DATA SPNA2 / -663.239, 37.8917, 4.7208, 0.0, -0.3080, 0.3958,            BLCK168
     1 0.2280, 4*0.0, -0.0288, 0.2064, 2*0.0 /                                 BLCK169
      DATA SPSA2 / -53.7385, 1.7751, 0.9225, 9*0.0,                            BLCK170
     1 1.1065, 2*0.0 /                                                         BLCK171
      DATA SPAS2 / -264.426, 0.0, 2.4897, 2*0.0, 0.0117, 0.0201 ,              BLCK172
     1 5*0.0, 0.8458, 2*0.0 /                                                  BLCK173
      DATA SPAF2 / -132.2034, 0.0, 3.1268, 2*0.0, 0.0142,                      BLCK174
     1 6*0.0, 0.o560, 2*0.0 /                                                  BLCK175
      DATA SPEU2 / 273.432, 4.0710, -10.5661, 0.0, 0.0124 ,                    BLCK176
     1 0.0704, 0.0187, 0.0, -3.7262, 2*0.0, -.0089, 0.7464, 2*0.0 /            BLCK177
      DATA SPDC2 / -0.8472, 2.2785, 1.4716, 0.0, 0.0163, 0.0166,               BLCK178
     1 -0.0118, 0.0, -3.7040, 1.3432, 7.499O, -0.0285,                         BLCK179
     2  0.7o64, 2*0.0 /                                                        BLCK180
      DATA SPCP2 / -209o.905 , 14.8542, -15.2164, 0.0, 0.1405, 0.0509 ,        BLCK181
     1 -0.0462, 0.0, 38.4844, 2*0.0, -0.0176, 0.3664, 2*0.0 /                  BLCK182
      DATA SPXX2,SPYY2,SPZZ2 /  45*0.0 /                                       BLCK183
      DATA SPNA3 / -304.3195, 1.3588, 1.7498, 0.0, -0.3039, 0.0490,            BLCK184
     1 0.3039, 0.0, 0.3553, 0.0, -1.0540, 0.0, 0.0259, 2*0.0 /                 BLCK185
      DATA SPSA3 / 11.8597, 0.2218, -0.2073, 3*0.0, 0.0133,                    BLCK186
     1 5*0.0, 0.2365, 2*0.0 /                                                  BLCK187
      DATA SPAS3 / 23.6930, 0.5691, -0.0228, 3*0.0,                            BLCK188
     1 0.0169, 0.0, -0.9578, 3*0.0, 0.8249, 2*0.0 /                            BLCK189
      DATA SPAF3 / 2.5149, 4*0.0, 0.0633,                                      BLCK190
     1 -0.0596, 5*0.0, 0.9515, 2*0.0 /                                         BLCK191
      DATA SPEU3 / 17.9147, 0.0936, 0.1346, 0.0, 0.0, 0.0285,                  BLCK192
     1 0.0132, 0.0, -0.9245, -0.0128, 0.0, 0.1270, -0.1660, 2*0.0 /            BLCK193
      DATA SPDC3 / -90.8726, 0.7364, -0.0694, 3*0.0,                           BLCK194
     1 0.1316, 2*0.0, 9.5891, -2.5012, 0.0, 0.0867,                            BLCK195
     2  2*0.0 /                                                                BLCK196
      DATA SPCP3 / -2.2851, 0.1149, -0.1144, 3*0.0,                            BLCK197
     1 0.0181, 0.0, 0.9647, 2*0.0, 0.0116, 0.3922, 2*0.0 /                     BLCK198
      DATA SPXX3,SPYY3,SPZZ3 /  45*0.0 /                                       BLCK199
      DATA SPNA4 / -1632.30, 0.0, 20.4601, 0.0, -.0546, 0.2073, 0.0899,        BLCK200
     1 0.0, 23.6679,-36.717,20.4268, -0.0394, 0.6201,2*0.0 /                   BLCK201
      DATA SPSA4 / -64.745, 0.0, 6.9791, 0.0, 0.0000, 0.0476, -0.0000,         BLCK202
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     1 C.0, 0.0C0000, 2*0.0, 0.0000, 0.6569, 2*0.0 /                    BLCK203
      DATA SPAS4 / -217.220, 2.3010, 1.0979, 0.0, 0.0000, 0.0022,       BLCK204
     1 -0.0014, 0.0,  4.1210, 2*0.0, 0.00000, 0.6589, 2*0.0 /           BLCK205
      DATA SPAF4 /  172.892, 0.0, 0.5967,0.0, 0.00000, 0.0,             BLCK206
     1 C.0068, 0.0, -1.1125, 2*0.0, 0.00000,  0.4641, 2*0.0 /           BLCK207
      DATA SPEU4 / -53.9699, 0.0000, 6.4073, 0.0, 0.0000, 0.0581,       BLCK208
     1 -0.0481, 0.0, 0.00000,-10.0202,-1.2401, 0.00000, 1.0172, 2*0.0 / BLCK209
      DATA SPDC4 / -109.355, 0.0, 0.346C, 0.0, 0.0000, 0.0030, 0.0334,  BLCK210
     1 C.0,  4.7217, -21.1530, 11.6799, 0.00000, 0.2575 , 2*0.0 /       BLCK211
      DATA SPCP4 /-123.532, 0.0,7.2646, 0.0, 0.0000, 0.0416, 0.0406,    BLCK212
     1 C.0, 0.1300, 2*0.0, 0.00000, 0.6874, 2*0.0 /                     BLCK213
      DATA SPXX4,SPYY4,SPZZ4 /  45*0.0 /                                BLCK214
C*********************************************************************
C                                                                      *
C                                                                      *
C        NOW SET UP DEMAND COEFFICIENTS                                *
C                                                                      *
C*********************************************************************
      DATA DMNA1 / 86.0780, 2*0.0, -0.3211, 0.0, 5550.44  ,            BLCK215
     1 -4697.89  , 2*0.0, 0.4945, 5*0.0 /                              BLCK216
      DATA DMSA1 / -242.9372, 0.0, -0.5409, 0.0, 0.0063, 1115.78,      BLCK217
     1 -697.0972, 82.3715, 0.0, 0.1055, 5*0.0 /                        BLCK218
      DATA DMAS1 / -514.7057, 0.0, -1.1146, 2*0.0, 1874.56  , -561.2801, BLCK219
     1 1367.06  , 0.0, -0.1079, 5*0.0 /                                BLCK220
      DATA DMAF1 / -32.4033, 5*0.0, 47.4345,                           BLCK221
     1 2*C.C, 0.8454, 5*0.0 /                                          BLCK222
      DATA DMEU1 / 27.4124, 0.0, -4.6775, 0.0, 0.0061, 0.0,            BLCK223
     1 1679.59  , 2238.56  , -6.7, .3122, 5*0.0 /                      BLCK224
      DATA DMDC1 / -25.3896, 0.0, -.1386, 0.0, -.0033, 443.3079,       BLCK225
     1 -384.6115, 62.992, 0.1095, .5935, 5*0.0 /                       BLCK226
      DATA DMCP1 /38.6775, 3*0.0, 0.0074, 0.0, 272.5126,               BLCK227
     1 2*0.0, .6277, 5*0.0 /                                           BLCK228
      DATA DMXX1,DMYY1,DMZZ1 /  45*0.0 /                               BLCK229
      DATA DMNA2 / -4183.63, -19.1363, 7.4081, 2*0.0, 7561.17  ,       BLCK230
     1 3*0.0, 0.0572, 5*0.0 /                                          BLCK231
      DATA DMSA2 / -309.394, -0.5884, 0.425, 0.0, -0.0115, 217.753,    BLCK232
     1 222.976, 85.416, 0.0, 0.4577, 5*0.0 /                           BLCK233
      DATA DMAS2 / -622.539, 4*0.0, 2276.56, -1400.87, 1698.41, 0.0,   BLCK234
     1 C.6405, 5*0.0 /                                                 BLCK235
      DATA DMAF2 / -47.3615, -0.144C, 0.0162, 0.0, -0.0056, 82.2036,   BLCK236
     1 -25.414, 121.9820, 0.0, 0.7731,  5*0.0/                         BLCK237
      DATA DMEU2 / -819.156, -5.4866, 3.6991, 0.0, -0.006, 6471.28  ,  BLCK238
     1 -4724.17, -702.510, 9.7779, 0.5569, 5*0.0 /                     BLCK239
      DATA DMDC2 / -250.5117, 3*C.0, -0.0003, 249.4954,                BLCK240
     1 136.47, -17.9442, 0.8435, 0.0, 5*0.0 /                          BLCK241
      DATA DMCP2 / -98.8737, -1.3719, -1.0510, 0.0, 0.0136, 1053.38  , BLCK242
     1 -441.702, 2*C.0, 0.7289, 5*0.0 /                                BLCK243
      DATA DMXX2,DMYY2,DMZZ2 /  45*0.0 /                               BLCK244
      DATA DMNA3 /  -69.6494, 0.0, -0.2269, 0.0, -0.0508, 258.0669,    BLCK245
     1 -110.7406, 4.6483, 2.4535, 0.2723, 5*0.0 /                      BLCK246
      DATA DMSA3 / -1.1617, 0.0, -0.0082, 2*0.0, 12.122, -4.5667,      BLCK247
     1 2*C.0, 0.1498, 5*0.0 /                                          BLCK248
      DATA DMAS3 / -28.8231, 4*0.0, 348.966, -267.7677, 108.6565,      BLCK249
     1 2*0.00, 5*0.0 /                                                 BLCK250
      DATA DMAF3 / -0.5931, 0.0, -0.0005, 2*0.0,-8.0050, 9.6087,       BLCK251
     1 2*0.0, 0.8520, 5*0.0 /                                          BLCK252
      DATA DMEU3 / -140.9059, 0.0, -0.4656, 0.0, -0.0417, 275.1772,    BLCK253
     1  35.1165, 2.3383, -0.3166, -C.1571 , 5*0.0 /                    BLCK254
      DATA DMDC3 /  -9.1576, 0.0, -0.0174, 0.0, -0.0010, 10.8335,      BLCK255
     1 1.7381, 0.0, 0.0169, -0.2691, 5*0.0 /                           BLCK256
      DATA DMCP3 / 24.9228, 0.0, -0.1561, 0.0, 0.0257, 0.0, 30.8044,   BLCK257
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     1 2*0.0, 0.5931, 5*0.0 /                                                  BLCK258
      DATA DMXX3,DMYY3,DMZZ3 /  45*0.0 /                                       BLCK259
      DATA DMNA4 / -284.1957, 0.00000, -.1992, 0.0, 0.00000, 3912.12,          BLCK260
     1 -3358.22, -690.386, 0.00000, 0.5432, 5*0.0 /                            BLCK261
      DATA DMSA4 / -271.6130, 0.0, -0.3217, 0.0, 0.00000, 275.334,             BLCK262
     1 106.235, 0.000000, 0.0,  0.0506, 5*0.0 /                                BLCK263
      DATA DMAS4 / -63.3329, 0.0, 0.0    , 0.0, 0.0   , 1671.27,              BLCK264
     1 -1310.1, 0.0    , 0.0, 0.5419, 5*0.0 /                                  BLCK265
      DATA DMAF4 / -67.5377, 2*0.0, 0.0    , 0.0   , 54.9771,                   BLCK266
     1 55.2746 , 0.0    , 0.0, 0.4645, 5*0.0 /                                  BLCK267
      DATA DMEU4 / -461.990, 0.0, -3.5502, 0.0, 0.0    , 2578.56,              BLCK268
     1 -1292.03, 527.504, 0.0   ,  0.0269, 5*0.0 /                            BLCK269
      DATA DMOC4 / -101.3741, 0.0, -0.5138, 0.0, 0.0    , 80.8690,             BLCK270
     1 58.7264, 41.4173, 0.0   , -0.0500, 5*0.0 /                              BLCK271
      DATA DMCP4 /   0.8382, 4*0.0, 976.323, -792.612, 2*0.0,                  BLCK272
     1 0.8136, 5*0.0 /                                                         BLCK273
      DATA DMXX4,DMYY4,DMZZ4 /  45*0.0 /                                       BLCK274
C*****************************************************************************
C                                                                             *
C                                                                             *
C         NOW SET UP SCRAP COEFFICIENTS                                       *
C                                                                             *
C*****************************************************************************
      DATA SRNA1 / -53.3241, 2.603, -2.7575, 0.0, .0614, .0441,               BLCK275
     1 -.0123, 0.0, .6844, 6*0.0 /                                            BLCK276
      DATA SRSA1 / -28.303, .3127, 0.1142, 0.0, .1205, -.1214,                BLCK277
     1 .0566, 0.0, .8098, 6*0.0 /                                             BLCK278
      DATA SRAS1 /5.3962, .5242, -.2841, 0.0, .0559, .0216, -.0126,           BLCK279
     1 0.0, .2315, 6*0.0 /                                                    BLCK280
      DATA SRAF1 / 15*0.0 /                                                   BLCK281
      DATA SREU1 / -89.9339, 3.0153, -0.1230, 0.0, .0697, -.0529,             BLCK282
     1 .006, 0.0, .4694, 6*0.0 /                                              BLCK283
      DATA SROC1 / -17.8776, .0083, 0.060, .3805, .3343, .2087,               BLCK284
     1 -.2909, -0.0175, 0.0, 6*0.0 /                                          BLCK285
      DATA SRCP1,SRXX1,SRYY1,SRZZ1 /  60*0.0 /                                BLCK286
      DATA SRNA2 / -258.2915, 20.7167, -11.9207, 0.0, 0.1217,                 BLCK287
     1 -0.0864, 0.0223, 0.0, 0.8704, 6*0.0 /                                  BLCK288
      DATA SRSA2 / -4.599, 3*0.0, 0.2071, -0.0914,                            BLCK289
     1 -0.0276, 0.0, 0.4244, 6*0.0 /                                          BLCK290
      DATA SRAS2 / -48.3004, 2*0.0, 1.9015, 0.2158, -0.0432,                  BLCK291
     1 -0.1318, 0.0281, 0.7860, 6*0.0 /                                       BLCK292
      DATA SRAF2 / -5.6969, 0.2811, -0.0364, 0.0, 0.0438, -0.0199 ,           BLCK293
     1  0.0170, 0.0, 0.6536, 6*0.0 /                                          BLCK294
      DATA SREU2 / -57.8215, 0.0, 2.9541, 0.0, 0.2723, -0.0780,               BLCK295
     1 -0.0115, 0.0, 0.4438, 6*0.0 /                                          BLCK296
      DATA SROC2 / -0.987 ,3*0.0, 0.2048, -0.1513,                            BLCK297
     1 0.0517, -0.0463, 0.6231, 6*0.0 /                                       BLCK298
      DATA SRCP2,SRXX2,SRYY2,SRZZ2 /  60*0.0 /                                BLCK299
      DATA SRNA3 / -28.0829, 0.0, 0.1934, 0.0,   0.0771, 0.0189,              BLCK300
     1  -0.0089, 0.0, 0.2840, 6*0.0 /                                         BLCK301
      DATA SRSA3,SRAS3,SRAF3,SREU3,SROC3,SRCP3,SRXX3,SRYY3,SRZZ3/             BLCK302
     1     135*0.0 /                                                         BLCK303
      DATA SRNA4 / 24.0660,2.0695, 3.6935, 5*0.0, 0.5930, 0.1538,             BLCK304
     1 -0.0940, 0.0    , 3*0.0 /                                              BLCK305
      DATA SRSA4,SRAS4,SRAF4,SREU4,SROC4,SRCP4,SRXX4,SRYY4,SRZZ4/             BLCK306
     1     135*0.0 /                                                         BLCK307
C*****************************************************************************
C                                                                             *
C                                                                             *
C   NOW SETUP PRCOEF, PROOT, AND PRICE.                                       *
C                                                                             *
C*****************************************************************************
```

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      DATA PRCF1 /  31.7104, 0.3950, -0.2602, -0.0016, 3*0.0,                BLCK308
     1 -0.4522, C.0, 6*C.0 /                                                 BLCK309
      DATA PRCF2 /  8.7083, 0.7973, -0.1468, -.0001, 3*0.0,                  BLCK310
     1 C.C, 0.0087, 6*C.0 /                                                  BLCK311
      DATA PRCF3 /  2.0132, 1.1054, -0.0947, -0.0699, 3*0.0,                 BLCK312
     1 3*0.C, 0.0372, 4*0.0 /                                                BLCK314
      DATA PRCF4 /  4.5626, 0.5872, -0.1674, -0.0013,  0.0   , 0.0    ,     BLCK315
     1 C.C    , 0.C    , 0.0418, -0.1382, 0.1553, 4*0.0 /                     BLCK316
      DATA PRDOT / -C.CC1, 0.0264, 0.0247, 0.0247 /                          BLCK317
      DATA PRICE / 2*0.0, 36.95, 25.89, 30.05, 25.21,                        BLCK318
     1 2*0.0, 25.89, 36.95, 25.21, 30.05,                                    BLCK319
     2 2*0.C, 127.09, 129.773, 115.24, 128.183 ,                             BLCK320
     3 2*0.C, 13.93, 129.773, 15.83, 128.183 /                               BLCK321
C*************************************************************************
C
C    NOW SETUP EXPARM AND DOTVAR.                                        *
C                                                                        *
C*************************************************************************
      DATA EXPNA / C.0, 1.25, 0.0, 11.49, C.0, 0.0380, 0.0, 5.33  /          BLCK322
      DATA EXPSA / 0.0, 1.48, 3*0.0, 0.0692 , 2*0.0 /                        BLCK323
      DATA EXPAS / C.0, 1.61, 3*C.0, 0.1051 ,2*0.0 /                         BLCK324
      DATA EXPAF / 0.0, 1.36, 3*C.0, 0.0714, 2*C.0 /                         BLCK325
      DATA EXPEU / 0.0, 1.27, 0.C, 11.21, 0.0, 0.0369, 0.0, 4.80 /           BLCK326
      DATA EXPOC / 0.0, 1.20, 0.0, 11.88 , 0.0, 0.0355, 0.0, 13.86 /         BLCK327
      DATA EXPCP / 0.0, 1.57, 6*0.0 /                                        BLCK328
      DATA EXPXX,EXPYY,EXPZZ /  24*0.0 /                                     BLCK329
      DATA CHANA / .0292, .0511, 0.0380, 5.33  /                             BLCK330
      DATA CHASA / .0349, 0.0, 0.0692, 0.0 /                                 BLCK331
      DATA CHAAS / .0493, 0.0, .1051, 0.C /                                  BLCK332
      DATA CHAAF / .0258, 0.0, 0.0714, C.0 /                                 BLCK333
      DATA CHAEU / .033, .0316, .0369, 9.09 /                                BLCK334
      DATA CHAOC / .0269, .0406, .0355, 7.98 /                               BLCK335
      DATA CHACP / .0543, 3*0.C /                                            BLCK336
      DATA CHAXX,CHAYY,CHAZZ /  12*0.0 /                                     BLCK337
C*************************************************************************
C
C SET UP DEM, SUP, SCRAP AND PAST PROD DATA.                             *
C                                                                        *
C*************************************************************************
      DATA QSUP1 /  0.0, 1876.7, 0.0, 1615.2, 0.0, 491.2, 0.0, 1357.8,       BLCK338
     1 C.0, 1c8.1, C.0, 378.6, 0.0, 1751.6, 6*0.0 /                          BLCK339
      DATA QSUP2 / 0.0, 5726.1, 0.0, 823.5, 0.0, 1567.5, 0.0, 437.4,         BLCK340
     1 C.0, 3597.3, 0.0, 459.7, 0.0, 3092.9, 6*0.0 /                         BLCK341
      DATA QSUP3 / 0.0, 207.7, 0.0, 24.9, 0.0, 75.5, 0.0, 56.2, 0.0,         BLCK342
     1 21.0, 0.C, 156.1, 0.0, 195.2, 6*0.0 /                                 BLCK343
      DATA QSUP4 / 0.0, 1426.7, 0.0,1034.8, 0.0, 382.5, 0.0, 240.4, 0.0,     BLCK344
     1 93C.6, 0.0, 493.7, 0.0, 1448.8, 6*0.0 /                               BLCK345
      DATA QSCP1 / 0.0, 507.8, 0.0, 50.0, 0.0, 139.2, 0.0, 0.0, 0.0,         BLCK346
     1 428.0, 0.0, 36.6, 0.0, 0.0, 6*0.0 /                                   BLCK347
      DATA QSCP2 / 0.0, 1615.0, 0.0, 87.1, 0.0, 829.6, 0.0, 16.5, 0.0,       BLCK348
     1 1210.3, C.0, 37.C, 0.0, 0.0, 6*0.0 /                                  BLCK349
      DATA QSCP3 /0.0, 10.286, 18*0.0 /                                      BLCK350
      DATA QSCP4 /C.0, 1226.0, 18*0.0 /                                      BLCK351
      DATA QSPRD1 / 0.0, 48710.0, 0.0, 25964.8, 0.0, 8237.6, C.0,            BLCK352
     1 31386.1, 0.0, 3378.9, 0.0, 4664.8, 0.0, 26073.1, 6*0.0 /              BLCK353
      DATA QSPRD2 / 0.0, 95624.1, 0.0,  3121.2, 0.0, 16745.3, 0.0,           BLCK354
     1 3272.5, C.0, 43663.0, 0.0, 3604.6, 0.0, 42474.5, 6*0.0 /              BLCK355
      DATA QSPRD3 / 0.0, 6412.9, 0.0, 388.2, 0.0, 264.0, 0.0, 413.8,         BLCK356
     1 C.0, 212.9, 0.0, 2513.8, 0.0, 3064.0, 6*0.0 /                         BLCK357
      DATA QSPRD4 / 0.0, 37906.7, 0.0, 18326.2, 0.0, 7906.7, 0.0,            BLCK358
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     1 7409.9, 0.0, 16421.6, 0.0, 11177.5, 0.0, 25957.2, 6*0.0 /                BLCK358
      DATA QDEM1 / 0.0, 2074.7, 2408.2, 2443.2, 0.0, 486.9, 473.8,              BLCK359
     1 375.2, 0.0, 1636.9, 1589.5, 1465.3, 0.0,1 15.9, 96.8,                    BLCK360
     2 94.7, 0.0, 2727.0, 2717.3, 2630.5, 0.0, 132.4, 128.8, 125.8,             BLCK361
     3 0.0, 2025.1, 2073.7, 2009.4, 12*0.0 /                                    BLCK362
      DATA QDEM2 / 0.0, 4765.0, 5357.7, 5316.9, 0.0, 603.2, 550.4,              BLCK363
     1 487.4, 0.0, 2368.0, 2486.8, 2329.6, 0.0, 179.1, 136.1, 133.3,            BLCK364
     2 0.0, 3682.7, 3669.4, 3394.3, 0.0, 243.6, 223.0, 206.9,                   BLCK365
     3 0.0, 2892.8, 2922.0, 2870.4, 12*0.0 /                                    BLCK366
      DATA QDEM3 / 0.0, 160.2, 190.1, 175.9, 0.0, 16.7, 12.2, 11.2,             BLCK367
     1 0.0, 139.9, 143.3, 109.0, 0.0, 6.6, 5.4, 5.2, 0.0, 206.7,               BLCK368
     2 229.5, 205.4, 0.0, 5.3, 4.8, 5.3, 0.0, 171.8, 172.6, 169.0,             BLCK369
     3 12*0.0 /                                                                 BLCK370
      DATA QDEM4 / 0.0,  942.9, 1154.1, 1196.1, 0.0, 339.5, 330.5,              BLCK371
     1 306.0, 0.0, 1152.3, 1209.8, 1154.0, 0.0, 132.8, 118.9, 115.2,            BLCK372
     2 0.0, 1627.9, 1626.2, 1612.3, 0.0, 120.0, 117.6, 107.6, 0.0,              BLCK373
     3 1562.7, 1529.1, 1525.3, 12*0.0 /                                         BLCK374
C*************************************************************************
C                                                                              *
C    SETUP DEFAULT PROGRAM PARAMETERS                                          *
C                                                                              *
C*************************************************************************
      DATA ICNTRY,IYR,IPRICE,IQDEM,IQSUP,IQSCP / 7,81,11,10,13,13 /             BLCK375
      DATA IYRSIM,IYRFST,IWORLD / 10, 82, 8 /                                   BLCK376
      END                                                                       BLCK377
//$DATA
```

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